THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 45. Thursday, October 8, 1931. No. 790.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

OCTOBER 12.

Institute of Metals (Scottish Local Section):—Ordinary meeting. "Some Random Reflections on Industrial Problems and Economies," Paper by L. Short.

OCTOBER 13.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Salving German Battleships at Scapa Flow," Paper by E. F. Cox.

OCTOBER 15.

Institution of Welding Engineers:—Ordinary meeting in London. "Autogenous Welding of Lead and its Alloys, Ancient and Modern," Paper by E. B. Partington.

Institute of British Foundrymen.

OCTOBER 9.

Sheffield and District Section:—Joint meeting at Sheffield. "Gases in Metals," Paper by Dr. W. Rosenhain.

OCTOBER 10.

West Riding of Yorkshire Branch:—Meeting at Bradford. Presidential address by A. S. Worcester.
Lancashire Branch (Burnley Section):—Opening meeting. "Cylinders, for Steam, Diesels and Compressors," Paper by F. J. Cook.

The Financial Situation and the Foundry Industry.

We have made it clear in a recent editorial that it seems wise to purchase pig-iron at the present time. It seems desirable to state in general terms that the departure from the gold standard should help the foundry industry, as it draws the major portions of its supplies from British sources. The light-castings industry should benefit in certain sections, such as in the bath and tub departments, as it will be increasingly difficult for the foreigner to make competition in the home market. The factor to which we attach the most importance is that to-day overhead costs are so onerous, that only when the shops are really well filled do they become reasonable. Thus, if we can nearly fill the shops with home-market requirements, then we can make effective competition overseas.

Foundries suffering from foreign competition, such as the manufacturers of steel castings and rolls, should quickly feel some relief, as many of the users of these commodities will be feeling a certain amount of relief also.

The non-ferrous foundries will find certain of their raw materials dearer, but they should have no great difficulty in passing off the enhanced prices to the customer, as engineers' buyers have long recognised the dependence of the non-ferrous founder on the metal market.

Those foundries which have taken advantage of the slack period to bring their foundries up to date will now reap the reward. It has been rather illuminating this last week to see that the firms which paid increased dividends had paid special attention to the organising of their foundries. We refer to Qualcast, Ferranti and Austins, and we congratulate the shareholders that in these three instances the directorate are exceptionally foundry-conscious.

Already certain of the foundries are feeling the effect of the new conditions, and we hear of a light-castings foundry in Scotland, a hardware shop in London, a malleable works in the South, are all working to capacity. Much better conditions are operating in South Wales, where both the coal and tinplate industries are experiencing a revival. A factor of paramount importance is the existence of large stocks of raw materials of all types in this country, and the profit on existing orders is such that, although we may have to pay enhanced prices for their replenishment, we should by that time be in a position of comparative prosperity and well able to pay for them. We counsel our readers to examine recent foreign inquiries and use the new conditions as an excuse for reopening negotiations on the new price levels. Material ordered before the departure from the gold standard, unless special provisions had been made, should be paid in sterling, because, when we adopted the gold standard in 1925, foreign supplies received a 10 per cent. bonus on all outstanding accounts, where negotiations were carried out in sterling. Thus, a precedent has been set.

Whilst we now possess better conditions for competing abroad, sight must not be lost of the fact that the salvation of British industry must come from harder work and effort, greater enterprise, rather than from political or advantitious aids. During the last six years of our adherence to the gold standard, the merchant has enjoyed an advantage over the manufacturer; it now appears as if the balance of advantage is to pass to the latter, but the former may still find ways and means of dealing with a difficult situation. In this connection it is interesting to note that one of the largest "independent" manufacturers of light castings stated to us at the beginning of this week that the new conditions would certainly place the British Ironfounders' Association on a firm footing. What we have said in the past, as to the necessity of making this Association 100 per cent. strong, applies with even greater force to-day, because of fluctuating conditions which may render rapid co-operative action in the political or commercial field an essential. At any time "co-operation," according to Harrington Emerson, "is a matter of course, not a venture; its absence is a crime."

It has been noted that the Scandinavian countries have departed from the gold standard, which makes their buying from Great Britain at a discount compared with purchasing from "gold standard countries," whilst allowing us to buy certain dairy products, iron ore and some ferro-alloys at a lower price than from most. So far as Denmark is concerned, it should be an added inducement to spend in Great Britain, her largest customer, the major portion of the money she now pays over to Germany, and so redress in some measure the exceedingly bad adverse balance of trade we have in our dealings with Denmark. This is also a factor which should reflect favourably on the British foundry industry, especially that section associated with agricultural implements and dairy machinery.

Notes from I.B.F. Branches.

Lancashire Branch.—The opening meeting of the Lancashire Branch of the Institute of British Foundrymen was held on October 3 at the Manchester College of Technology, Mr. Roy Stubbs, who has been elected President for the second year in succession, occupying the chair. He did not on this occasion deliver an address, as the chief business of the meeting was the consideration of a Paper read by Mr. W. West, of Leyland Motors, Limited.

The President asked Mr. West to bring forward the scheme which has been mooted for the formation of a Section of the Branch in the Preston area, where for some time past short lectures have been given by Branch members to interested foundry operatives. It was felt that the time was now ripe to ask for more support for this scheme of educating the practical men on more advanced matters; it would receive every possible support from the local firms. The matter was promised the fullest consideration in view of the possible influx of new members to the Branch, and it is hoped to be able to arrange a propaganda meeting shortly in the Preston area, and, possibly, also a short series of Papers at intervals throughout the coming winter session, in the hope that sufficient enthusiasm will be shown to warrant the formation of a Section. Mr. Stubbs also proposed that the congratulations of the members should be sent to four of their members who had received distinctions from the Manchester Association of Engineers, with which Society reciprocal relations were of the happiest order. At the opening meeting, to be held on Friday, the Constantine Gold Medal for the best Paper during the last session was to be presented to Mr. F. W. Rowe, B.Sc., for contributing data on "The Selection and Treatment of Gear Materials," and the Butterworth Gold Medal for the best series of contributions to the discussions of the season's Papers to the Association to Mr. J. S. Glen Primrose, A.R.T.C. In the Student Members' Section of the Manchester Association of Engineers, the Pilling Prizes for the best-written contributions had been awarded to two members of the Lancashire Junior Section of the Institute, namely, Mr. E. Garside, dealing with "Rolling-Mill Machinery," and Mr. E. Sutcliffe, who discussed "Some Faulty Designs."

For the first time the Lancashire Branch has published its syllabus together with that of the Burnley Section and of the Junior Section, in a 52-page booklet. In addition to the usual list of officers, it is interesting to note the large share the members take in the activities of the General Council committees, and useful reminders of the holders of various Institute medals and diplomas are given. The President's appeal is a strong incentive to renewed vigour in supporting the activities of the Branch.

London Junior Section.—The London Junior Section of the Institute of British Foundrymen held the opening meeting of its new session at the offices of the Foundry Trade Journal on September 25, Mr. L. H. Howell, the chairman, presiding. Mr. H. C. Dews, President of the London Branch, who had kindly consented to address the members, spoke of the new foundry educational scheme, the establishment of which, he said, was one of the most important pieces of work the Institute had yet accomplished. The craft-certificate scheme was operated in conjunction with the City and Guilds of London Institute, and covered two courses—one for pattern-making, of four years' duration, and the other for foundry practice, lasting three years. Co-operation of the technical colleges and institutes had been secured, and instruction would start this winter. Students who contemplated entering for these certificates would do well to do so early, as in the course of time the examinations would undoubtedly be made more difficult. The national certificate, which was almost equivalent to a University degree in science or metallurgy, was operated in conjunction with the Institution of Mechanical Engineers, and really would require day training in addition to evening tuition.

Mr. Dews, concluding his remarks, stated that possession of a certificate would "label" entrants to the industry as qualified foundrymen, and that employers, when considering applications for positions, would attach a definite value to these certificates and would be biassed in favour of certificate holders. A vote of thanks, proposed by Mr. L. H. Howell and seconded by Mr. B. B. Kent, was accorded Mr. Dews for his address.

Scottish Branch.—The council of the Scottish Branch of the Institute of British Foundrymen has been conducting a publicity campaign to bring to the notice of patternmaking and foundry apprentices the course of studies for the City and Guilds of London Institute craft certificates. The Education Committee of the Corporation of Glasgow has instituted suitable classes for the current session, and, at the request of this Committee, the Branch Council has appointed an advisory committee to assist in the planning and equipping of the foundry department of the new Glasgow Trade School, and also to consult with the staff as to the conduct of the classes.

Wales and Monmouth Branch.—The Wales and Monmouth Branch of the Institute of British Foundrymen opened its session last Saturday with a whist drive at the Park Hotel, Cardiff. There was a large gathering, the aim of this event being to interest the ladies in the work of the Institute, in order that they might form a Ladies' Committee, at a later date, to co-operate with the Branch Council in its arrangements for the Annual Convention of the Institute which, it is expected, will be held in Cardiff in 1933.

At the conclusion of the whist drive the prizes were distributed by Mrs. C. Edward Williams, wife of the Junior Vice-President of the Institute. This ceremony was followed by the presentation of a diploma to Mr. J. Hird, and in a short speech Mr. C. Edward Williams thanked the employers of Mr. Hird (Lister & Company, Dursley) for co-operation in the experiments which made the Paper so interesting and valuable. By its publication knowledge was disseminated which was invaluable to foundrymen the world over.

A vote of thanks to Mr. and Mrs. C. E. Williams was proposed by Mr. R. G. Williams and seconded by Mr. W. R. D. Jones, and another to the organiser of the whist drive, Mr. W. Williams, proposed by the hon. secretary, Mr. J. J. McClelland.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Economics—Again.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. Savage's original letter was treated seriously and read more than once before being contested. Non-agreement with him is, let us hope, not necessarily a sign of incompetence to discuss the subject, as your correspondent suggests. Possibly, it may be the reverse.

Mr. Savage has said—in a paragraph he has asked me to re-read—that part of the reduced cost of living at one period was due to monetary deflation. This can only mean that it was due to our nearing, and, ultimately, adopting the gold standard. I find it hard to conceive that a deflation which, irrefutably, increased the cost in gold of labour for a given amount of service, could reduce the cost of living. Unless that point can be solved, I feel that either Mr. Savage is, or I am, off *terra firma*.—Yours, etc.,

Victor Stobie.

Dunston-on-Tyne.
September 29, 1931.

Random Shots.

Mexico captured "Marksman's" fancy in the springtime of life. It symbolised for him the perfect home of Lyceum melodrama: there were bandits and greasers; castanets and caballeros; duels, ransoms, revolutions, policemen arrayed in beach costumes and any number of Past-Presidents—sufficient, in fact, to supply a technical association with a whole general council. And now, in that land of freedom, the decree has gone forth that every Mexican must bathe at least once a week; that he who bathes not shall be bathed. Dissolving the "ancestral grease of the greaser" is to be compulsory.

* * *

I am led to speculate lightly as to the possible effect of this decree upon the possible prosperity of our bath manufacturers. Voiced opinion seems agreed that the depreciation of our currency abroad will have a favourable influence particularly upon the bath section of our light-castings industry. The exclusion of imported baths will bring much more work to British bath-tub foundries; increased production will lead to lower costs; lower costs will enable them to compete with fuller success in the markets of the world; and—why, we are half along the road to prosperity!

* * *

Here is a new market created by the decree of a government! But how often, like the clown, we are there before our legs. Very unfortunate it would be if, when consignments of Falkirk baths were tossing on the high seas, the present Mexican Government were succeeded abruptly by another, which declared null and void the Order of the Bath of its predecessor.

* * *

I read with some amusement the tale of Grey Towers, the home for forty years of the late Sir Arthur Dorman. The estate, the rental of which is over £3,500 a year, was announced for sale. Representatives of a large film company approached the auctioneers and offered to buy it, lock, stock and barrel. Their intention was to use it in a bombing film—as the objective. Grey Towers would be blown to smithereens to show the awful effect of bombing. The contract was not completed.

* * *

It seems desirable that Branch secretaries of the Institute of British Foundrymen should arrange for a technical Paper to follow the Presidential Address when the latter is likely to be short. There exists within the Institute a long-established custom that no discussion of a President's Address shall be allowed; a custom, to "Marksman's" way of thinking, better honoured in the observance than in the breach. Mark you, there may be discussion, camouflaged as a vote of thanks with lengthy support; but where it has been conducted openly the participants have come near to breaking the rules of the Institute by harping on such strings as wages, price levels and politics. "Marksman," humble student of philosophy, would much like to see this tendency turned aside as being the thin edge of an unwanted wedge.

Marksman.

The Pan-European Foundry Exhibition at Milan.

MODERN CORE-MAKING MACHINERY FEATURED.

The first foundry exhibition to be held in Italy was opened at Milan on September 12 for two weeks. It occupied the large Machinery Hall of the Milan Fair, a group of permanent buildings somewhat on Wembley lines, but used regularly for trade fairs each spring. The exhibition was not completely international, for, under the arrangements governing these displays, America did not participate this year, and British participation was very limited. There was strong representation, however, from France and Germany.

The display was remarkable, considering that this was the first venture of its kind in Italy, and bearing in mind the absence of organised bodies on the technical, research and equipment sides. It presented several features markedly different from other exhibitions, at any rate those in this country and U.S.A. The first, perhaps, was the extent of the participation of producers of castings—iron, steel, malleable, non-ferrous—in addition to that of suppliers of material and equipment. Secondly, there was an interesting display of art castings, some being shown in various stages of manufacture. These are produced in the main by a number of small foundries, which worthily carry on the artistic traditions for which the country is famous.

Nature of Exhibits.

The exhibition was divided into four groups; raw materials, such as coke, refractories and the metals and alloys required by the founder, with moulding sands, graphite and blackings, being in the first group. The second group contained exhibits of castings, including art and ornamental castings. Group three comprised equipment for melting and thermal treatment, sand treatment, for moulding and core making, conveying and transport, and for control and testing. The fourth group contained exhibits by schools and scientific and technical associations.

British Exhibits.

It is unnecessary to give descriptions of any length for many of the exhibits, for they have been previously described in our columns when shown at the London and other exhibitions, and, indeed, comparatively little shown was really novel. It may well be doubted whether annual intervals are long enough to show striking changes. Among the British exhibits were British & Continental Traders, Limited; Harrison Bros., Limited; Tennant, Sons & Company, Limited; General Refractories, Limited; Vickers-Armstrongs, Limited; Beecroft & Partners, Limited, and the Carborundum Company, Limited, the first-mentioned including exhibits of well-known pig-irons, such as Grazebrook, Lowmoor, etc., and Akrill rolls. We hope that their enterprise will be rewarded.

The castings on view gave an excellent impression of the nature and range of work done in Italian foundries, for they showed a very good surface and finish, and came from such well-known establishments as Cogne, Ansaldo, Breda, Vanzetti, Ilva, Stigler, Alfa-Romeo, Fiat, and Isotta-Fraschini. They included all sizes and types in grey iron, malleable, steel and non-ferrous alloys, including electron.

Core-Making Machinery.

The undoubted novelty of the exhibition was a machine for making cores of a comparatively small and simple character by compressed air. Three makers were showing these core-blowing machines—the Société Anonyme des Aciéries ci-devant Georges Fischer, of Schaffhausen; Gustav Zimmermann, of Düsseldorf, and the Badische Maschinenfabrik, of Durlach. In the machine of the first-mentioned firm, sand is fed by means of a small conveyor into a hopper at atmospheric pressure. Any type of moulding-machine sand can be employed, and either green sand or oil sand. The core box is placed under the nozzle of the machine and the sand is forced in by compressed air, the actual pressure being on for 8 or 10 secs. It was stated that 80 or 120 cores per hr. can be made by one man, the production being further increased if an assistant (boy or girl) is employed. About 8 cub. ft. of air are required per core, more or less according to the size of the box. Three sizes are made, the hopper capacity being 6, 15 and 30 litres in the three cases. On the largest machine cores up to 16 in. wide can be blown horizontally, up to 6 ft. in length, and vertically cores can be blown up to 3 ft. For longer pieces the machine has to be supplied with a longer vertical column. The width of the box is limited by the vertical columns of the machine. A small electric motor (3 h.p.) in operation during the blowing of the core is the only remaining power required, this being used to agitate the sand in the hopper to avoid coagulation of the sand or any tendency to "bridging." The same firm makes the Nicholls moulding machine of the jolt and squeeze type, this being said to be used for 70 per cent. of the automobile castings output in U.S.A. Machines up to 10 tons are made for 6- and 8-cylinder blocks. The firm employs about 6,000 people in its foundry plants, making grey iron, whiteheart malleable and steel. Steel road wheels for automobiles are made on a conveyor system from the Heroult furnace, pouring at intervals of four hours.

The core-blowing machine exhibited by Gustav Zimmermann worked on a similar general principle, the output being given as 60 to 80 per hr. with one man, rather more if an extra assistant is employed, and more on a small and simple core. A third type, that of the Badische Maschinenfabrik, Durlach, was stated to have an output of 100 to 200 cores per hr. Two sizes are available. Neither of the two last-mentioned types use the auxiliary electric motor.

Collective Exhibits.

The production of ferro-alloys appears to have been rationalised to some extent in Italy, for all the producers had a comprehensive and collective exhibit, all produced in the electric furnace, and hence providing almost any carbon content required. Another combined exhibit was shown by a consortium of Italian makers of refractory materials.

Among the German exhibits were cases of the pig-iron known as "Silbereisen," made by the Friedrich Wilhelms-Hütte, Mulheim (Ruhr), having a carbon content of 2.8 per cent. and of fine grain and texture, chill-cast. A new type of pig-iron of small graphite content and known as "Migra-eisen" was also on view.

The French exhibits included the well-known plant and machines of Bonvillain and Ronceray, and the moulding machines and sand plant of A. Utard, from whom Ealing Park Foundry has acquired British rights. The Nickel Information Bureau and the Aluminium Information Bureau both had exhibits, and some admirable castings in light alloys were displayed by Fiat, by Isotta-Fraschini, and by Alfa-Romeo. The Tecnomasio Italiano Brown-Boveri had an interesting exhibit of Heroult furnaces of the type developed and used by them.

Various foundry associations and teaching institutions showed their respective fields of work, the German exhibit including the efforts of works themselves, the technical high schools, the various societies for co-operative action in the industry, the standardising institutions and the research institutions. The Italian schools, chiefly those of Milan and Turin, arranged displays on the lines of the technical exhibit given at the London exhibition of 1929.

An attempt had been made to form a museum exhibit, but it was striking mainly by the incongruity of such items as could be got together, including the original Stassano arc furnace of 1902, early bronze guns and Roman remains. Altogether, however, the exhibition was one on which the organisers could be congratulated.

Members of the Institute of British Foundrymen and their Ladies who Attended the International Foundry Congress at Milan.

E. Bean, Hull; H. D. Campbell and Mrs. Campbell, Glasgow; J. Cameron and Mrs. Cameron, Kirkintilloch; V. Delport and Mrs. Delport, London; W. Donnon and Mrs. Donnon, London; W. J. Flavell, West Bromwich; T. H. Gray, London; W. Jolley, Mrs. Jolley and Miss Jolley, Manchester; G. T. Lunt, Wolverhampton; T. Makemson, Manchester; Dr. A. L. Norbury, Birmingham; J. G. Pearce, Birmingham; J. M. Primrose, Mrs. Primrose and T. Primrose, Falkirk; W. Rawlinson and Mrs. Rawlinson, Manchester; H. Shillitoe, London; S. W. B. Stephen, Birmingham; R. W. Stubbs and Mrs. Stubbs, Manchester.

WORKS VISITS.

Officine Meccaniche Stigler.

The number of alternative visits offered precludes any reference to more than those actually seen. Those fixed for September 14 included the Officine Meccaniche Stigler and the Fabbrica Automobili Isotta-Fraschini. The Stigler plant is in the heart of Milan, and makes lifts and a variety of engineering products. As with many English works, the foundry is separate from the main works, in a building several hundred yards distant. It is an admirable example of a foundry producing a wide variety of castings, apparently for outside use as well as for its own shops. At the time of the visit the sand-treatment and conveying system was being replaced, the design providing for knock-out sand to fall through a grating to a band conveyor removing it to the sand-treatment plant at one end of the shop, whence it would be delivered overhead to the machines and used as required from manually-operated hoppers. A much larger proportion of the work appeared to be dry sand than would be found in an English foundry. The cupola plant was of usual Continental type, the furnaces being fitted with receivers. A special feature of the foundry was the production of precision die-castings under pressure in brass, bronze, aluminium and white alloys and in silumin. Special irons are also made, yielding about 19 tons tensile, as well as a non-magnetic iron.

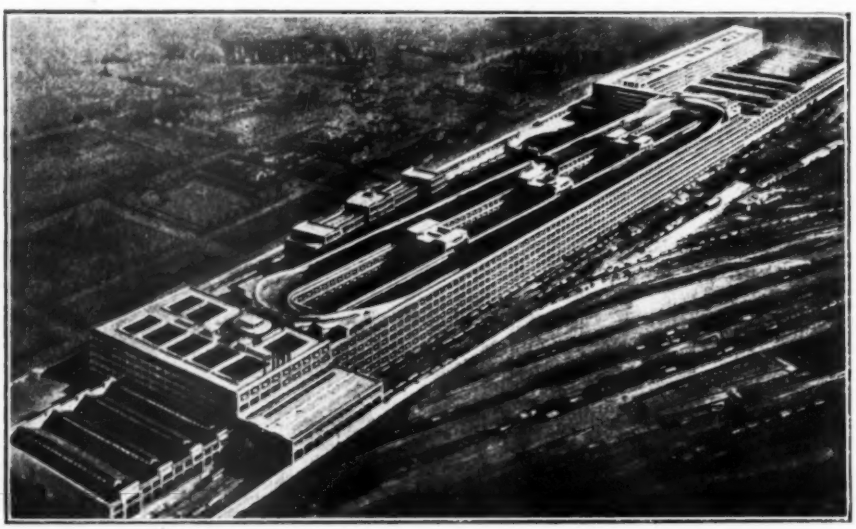
Isotta-Fraschini.

Apart from a small oil-fired furnace producing grey-iron castings, the cupola appearing to be used very seldom, the whole of the production of the Isotta-Fraschini foundry was in non-ferrous metals, chiefly aluminium alloys and electron. The works produces the high-class automobile of the same name. In one shop a sand-treatment and conveying plant and moulding machine had been installed to produce one casting in electron. Schmidt oil-fired furnaces were used for melting, and a modification of this type was being used for cast-iron melting,

the furnace being inclined and rotating about its axis. A bronze melt required about 35 to 45 min. to melt 6 to 7 cwt., while a charge of cast iron required 80 min., the fuel consumption being about 20 per cent. and pouring temperature 1,350 deg. C. The production of high-quality materials, especially non-ferrous alloys, tends towards drawing-room conditions in the foundry with respect to light and air and general cleanliness.

The Cogne Works.

On September 16 the visitors left Milan for St. Vincent or Aosta, and on September 17 the whole party inspected the steelworks of Cogne, situated near Aosta at a height of 2,000 ft. above sea-level. The works draws its supplies of iron ore by telpher from Cogne, the mines of which some of the party visited next day. The plant consists of blast furnaces of most modern type, one of which was producing during the visit. The metal is removed to mixer or cast into pigs. The steel plant is housed in a fine shop containing a number of electric furnaces and Bessemer converters. The rolling-mill plant is adjoining. It is understood that the works was commenced just before the war, which, of course, considerably modified the course of events, and has since become a works of most modern type.



An Aerial View of the Fiat Works at Lingotto, showing the Testing Track on the Roof.

During the following two days the visitors returned to Ivrea to see the works of the Olivetti Typewriter Company, Limited, and the Fiat works at Turin. The former works employs about 800, and the foundry not only supplies the works requirements for precision castings, but also a number of outside engineering works with electrical, textile and automobile castings. Two small cupolas are used, made by Olivo, and the bulk of the production is obtained on pneumatic machines of the jolt and squeeze type, mainly French and American in origin. Very great care is taken in the preparation of sand and cores, the finish on these being greatly admired. Equipment is provided for annealing and sand-blasting. The automatic machinery is of the most modern type, and a very complete planning system ensures regularity in the flow of work through the departments.

The Fiat Concern.

No brief description can do justice to the Fiat works. This group of industries, employing 35,000 people in 12 factories, began in 1899 as a motor works to emancipate Italy from dependence on foreign automobiles. The works now cover between 7 and 8 square miles. The main assembly department is at Lingotto, a suburb of Turin, and is a five-storey building carrying on its roof the well-known testing track. This building is now flanked at its ends by six-storey buildings, giving a total length of over 1,000 yds. Work progresses upwards from floor to floor, and ramps at each end enable car traffic to proceed up and down. The visitors in fact went through this building by motor-coach. Chassis and body meet at the top, and the car is then tested on the track.

In addition to motor vehicles of all types, the works builds aero engines and planes at three plants, Diesel engines, tractors, carriage and wagon work, etc. The ironworks includes four 25-30-ton Siemens-Martin furnaces and six Fiat electric furnaces. Both batteries produce 1,000 tons of steel per day, and the rolling-mill plant enables all ordinary constructional requirements to be met. The steelworks can produce 150 tons per day of special and alloy steel from Fiat electric furnaces. This group is completed by a metal industries division for forging, stamping, etc.

The foundry division consists of two buildings, having an area of over 300,000 sq. ft., which are fitted to produce all the grey iron and non-ferrous castings required for the other factories, particularly, of course, the automobile side. A special feature is made of die castings, very large castings being made in this way; a special shop makes the dies. Here again were to be found clean, light and airy shops admirably equipped and provided with all necessary technical control. The brevity of the time available, the inevitable difficulties associated with visits of parties, which raises the difficult problem for the works of suitable guides, added to the language difficulty, prevented the fullest appreciation of the work of this group of establishments, but the visits sufficed to reveal the nature of the foundry art practised in Italy, and it is one on which the country may be warmly congratulated.

Technical Papers.

Those who know the difficulty of discussing adequately half-a-dozen Papers during an Institute of British Foundrymen's Convention will understand the limitations on the discussion of Papers at the Milan Congress. They were between forty and fifty in number, and were not printed in advance, except in brief abstract, which became available shortly before the Congress opened. Some of the Papers bore only an indirect relationship to foundry practice, and others were presented apparently on behalf of industrial firms. These drawbacks notwithstanding, the discussions were vigorous in character, and will best be reviewed when the full text of the Papers presented is available.

Mr. Le Thomas drew attention to what he described as the remarkable Paper presented by Dr. A. L. Norbury to the Institute of British Foundrymen's Conference in 1929 on "Manganese in Cast Iron." His experience confirmed that "inverse chill" and other troubles were associated with low manganese, and he had succeeded in eliminating them by the use of a pig-iron containing 2 to 3 per cent. manganese. Dr. Norbury's own Paper to the Congress on malleable iron test-bars has already been reproduced in these columns, as has the complete list of Papers presented. Two other Papers dealt with ingot moulds and with rolls from electric furnace iron.

THE CLOSING MEETING IN ROME.

At the conclusion of the International Foundry Congress in Milan, about 60 participants and their ladies undertook an extensive tour of Northern Italy, visiting Aosta, Turin and Genoa. The party then proceeded to Rome, and after staying there for one day they departed for a two days' tour in Umbria. A detailed account of these tours will be given in our next issue. On returning to Rome, the party was joined by a large number of Italian and foreign delegates and ladies for the concluding sessions of the conference.

On Friday evening, September 25, the Governor of Rome, Prince Buoncompagne Ludovisi, gave a reception at the Campidoglio. This gathering was one of the most magnificent and imposing functions ever tendered to foundrymen, and was attended by several hundreds of people. The corridors and staircases were lined with the Governor's servants in scarlet and gold uniforms. The guests were conducted by the Governor through an imposing suite of chambers adorned with priceless works of art. An orchestra played operatic music, and refreshments were provided in several of the saloons.

The closing meeting of the Congress was held in the Campidoglio on Saturday morning, September 26. Several hundred delegates and ladies assembled in the magnificent Hall Julius Cæsar. The front two rows were occupied by Ministers of State and prominent officials, the various official representatives of the foreign foundry associations occupied the third row, and the remainder of the foreign members and ladies were accommodated immediately behind. At 10.30, Signor Mussolini entered the room accompanied by the Governor of Rome and other high officials, and was greeted with loud applause. The Duce took the chair and was supported on the platform by the Governor of Rome, Mr. A. Damour, President of the International Committee of Foundry Technical Associations, and Comm. Carlo Vanzetti.

Signor Mussolini's Address.

The Duce said that he first wished to thank the General Committee of the Exhibition and the Committee of International Foundry Congresses for having invited him to be present at the closing ceremony of the Congress, which was the sixth of a series commenced in 1926. He had followed closely the work of the Congress, and, though without having great knowledge of the subject, he had received the impression that the discussions and decisions had been very interesting, and were of importance to the future activities of the participants. The progress already made, and the still greater progress to be recorded in the future, was due to the co-operation which existed between scientific research and industry.

After the work of the Congress, the Duce had followed with interest the tour they had made through the industrial regions and natural beauty-spots of Italy. This tour had made it easy for them to realise how Italy had penetrated into the field of industry, in spite of

conditions which were not naturally favourable. They would have noted the order, the discipline and the good conduct, both during and after working hours, which pervaded the community. Their experiences would provide material for refuting many falsehoods and slanders which, by certain people, had been stuffed into the minds of the credulous and ill-informed. On the other hand, it was their duty to the world to tell the truth.

The Congress had evolved during its sessions enough movement in the economic history of the world; from their work and from their research a moral might be drawn, which was: That without the fusion into one spirit of unity of all the good factors operating, the crisis from which we were all suffering would last much longer still. It was necessary to work in order that that spirit of unity and of international collaboration in all fields of labour would be promoted in the practices of life; then many problems would find their logical and happy ending.

With these words, he asked them to accept his best wishes and, in the name of the King, he declared the Sixth International Foundry Congress to be closed.

At the conclusion of the meeting, the Duce left the room and passed into an adjoining saloon, where Comm. Vanzetti presented to him representatives of the foundry associations of each of the countries represented. The British delegates presented were Mr. John Cameron, Past-President of the Institute of British Foundrymen; Mr. T. Makemson, general secretary; and Mr. V. Delport, representing the American Foundrymen's Association.

At midday a luncheon was given at the Casino Delle Rose by the Confederazione Generale Fascista Dell'Industria Italiana, at which each of the visiting associations took the opportunity of expressing their thanks to the Italian industrialists for their hospitality during the Conference, for the opportunities afforded of inspecting Italian industrial development, and for the numerous tokens of goodwill which had been extended to the visitors. Mr. John Cameron spoke on behalf of the British delegation.

On Sunday morning a number of delegates and ladies of various nationalities visited the Vatican, and did homage to His Holiness the Pope, who had graciously consented to receive them. After the visitors had kissed the ring, they were addressed by His Holiness. The British delegates and ladies who were so honoured were Mr. and Mrs. John Cameron, Mr. V. Delport, representing the American Foundrymen's Association, and Mrs. Delport, Mr. and Mrs. J. M. Primrose, Mr. T. Primrose, Mr. and Mrs. W. Donnan, Mr. and Mrs. R. W. Stubbs, Mr. and Mrs. W. Jolley and Miss Jolley, and Mr. T. Makemson.

Applications for Trade Marks.

The following list of applications to register trade marks is taken from the "Trade Marks Journal":

"Monum."—Non-ferrous metals. Billington & Newton, Limited, Vulcan Foundry, Station Street, Longport, Stoke-on-Trent.

"Birmabbright."—Metals. The Birmingham Aluminium Casting (1903) Company, Limited, Dartmouth Road, Smethwick, Birmingham.

"Baldurie."—Metal goods and machinery. Henry Balfour & Company, Limited, Durie Foundry, Leven, Fifeshire.

"Brytcast," over device.—Metal castings in the rough. Brytcast Stainless Metals, Limited, Green Lane, Blackheath, Staffordshire.

"Duboflex."—Metals. John King & Son (Enamellers), Limited, Pyro Works, Foundry Street, Whittington Moor, Chesterfield.

"Superston."—Metals. J. Stone & Company, Limited, Deptford, London, S.E.14.

Lead-Base Metal *versus* High-Silicon Iron.

By "Foundry Manager."

Engineers usually specify high-silicon iron or lead-base castings when designing acid-manufacturing plants, and both present, to the inexperienced, grave difficulties. These difficulties, in normal trade conditions, need never arise, because the foundryman probably has sufficient work in prospect with which he is thoroughly familiar, without having to indulge in experiments on work he does not quite understand. In times, however, like the present, the jobbing foundryman is gratified to obtain any type of work.

The following account gives the writer's experience in producing lead-base containers, the difficulties encountered and how these were overcome. Section A in Fig. 1 shows a cross-section through the mould ready for pouring, whilst plan B shows the shape of the heavy top flange, and section A, B shows the grid holder.

The first mould was made of red sand mixed with ordinary floor sand, and was not dried. It was rammed quite hard and well vented.

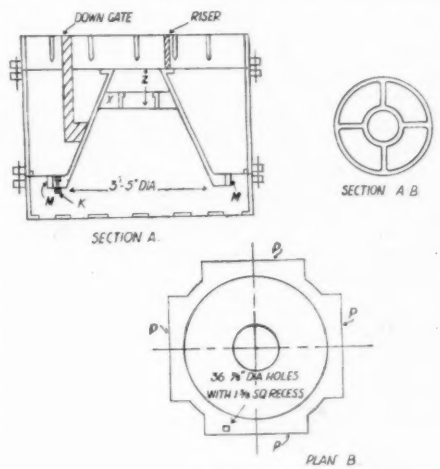


Fig. 1.

The 36 bolt holes in the thick flange, it will be noted, are for accommodating square-headed bolts. These cores were made of ordinary core sand, with a core-gum binder. The top core X was also made of the same material. The portion of the inside of the cone pattern, as arrowed by Z, was filled in with a loose piece of wood, so that when the pattern was lifted out this was left on the sand cone; this, in its turn, was removed, and the dried core X placed in its position. Thus the wood portion really formed a print for the core X, which was made from a special core box. The pattern was an iron shell, struck up on a spindle. It would have been perhaps better of wood, on account of lightness, but it was thought that, of iron, it would retain its shape better, even if it were rather heavier. The special lead melted at a quite low temperature, and remained in the fluid state for a reasonably long time. It was melted in a large ladle, using a local coal fire. The contraction of the metal was just under that of cast iron. When the casting arrived at the cleaning shop the next morning, it was found to be very rough on the outside, but not so bad on the inside. The heavy square sides, P, P, P, P, had gained and swollen into very irregular shapes. The greatest trouble, however, was with the square to round cores through the thick flange. The metal had so badly eaten into these cores that the holes had to be literally punched out. After a great amount of dressing, scraping and machining, the casting was presentable.

To have continued with the balance of the containers on similar lines would have meant a considerable loss on the job. After discussion, it was decided to try chills. The heavy flange was to be chilled as shown by chills marked M,M, one on each side; these were placed to the pattern and rammed up with the mould. A little difficulty presented itself with regard to the 36 holes in the thick flange. These cores must be placed in correctly or the squares would not be uniform. For this purpose, and in order not to have any print on the top side of the mould, a square print was placed on the bottom side of the pattern, as shown by K.

Obviously, if the chills which were to replace the cores were made to follow this print, they could not be stripped properly, as both ends were larger than the middle, unless they were broken out. All the chills were made of cast iron and coated with plumbago. Rather than make 36 new chills each time, it was thought that if the bottom part which would form the portion that filled the square print could conveniently be made of sand, the trouble would be overcome. Each chill was therefore made with that end reduced and roughened. It was then placed in the original core box and filled exactly the shape of the box except at the reduced end. Strong oil sand was rammed in around this end and took the shape of the box, which was square. The chill was then placed in the stove, to dry the sand end. It will be seen that the chills could easily be knocked out after casting.

The second mould was rammed up of loam sand mixture instead of red and black sand, and the whole was dried in the core stove.

When dressed and the chills knocked out, the second casting had a beautiful smooth skin inside and out; it was true to shape without any swells, and the 36 bolt-holes were as clean as though they had been drilled or punched. This casting, however, showed shrinkage under the round top flange. This was re-melted and poured up with a fresh supply of lead, and this made a good job. The finished casting weighed nearly 1 ton. Reverting to the heading of the article, from the foundryman's point of view the lead-base casting is less risky to make than the high-silicon iron one.

Dilatometric Study of Chromium-Nickel-Iron Alloys.—The following is a summary of a Paper by Vsevolod N. Krivobok and Maxwell Gensamer, in Technical Publication No. 434, issued by the American Institute of Mining and Metallurgical Engineers. Certain chromium and chromium-nickel steels in the stainless range can be hardened by a treatment consisting of a rapid cooling to room temperature followed by immersion into a liquid well below room temperature. A mixture of solid carbon dioxide and acetone provides a sufficiently low temperature to accomplish this increase in hardness, which in several alloys has resulted in hardness of over 50 Rockwell C. The study of the process of hardening was made, using for this purpose dilatometric observations. It has been demonstrated that the increase in hardness is due to the decomposition of austenite at low temperatures and that the progress of the phase change is a function of temperature. Only a few minutes are necessary to establish a quasi-equilibrium between the retained, meta-stable austenite and the chromium-nickel ferrite and carbides, at any temperature. The effect of nickel on iron and chromium alloys containing about 18 per cent. chromium is to lower the temperature at which the gamma to alpha transformation occurs on cooling, and to oppose raising this temperature by "soaking," as can be accomplished in iron and chromium alloys containing little or no nickel. The effect of carbon is the same in this latter respect, but its effects on the temperature of transformation on cooling is less than that of nickel. With 0.05 per cent. carbon between 4 and 8 per cent. nickel is necessary to retain some of the austenite on quenching, but as the carbon content is increased to about 0.25 per cent., 2 per cent. nickel is sufficient. It is believed that the treatment as described may, and probably does, considerably change the mechanical properties of chromium-nickel-iron alloys. The necessity for further investigations is stressed and the tentative plans for immediate future work indicated.

The Demand for Cast Iron—Past and Present.

By "Vallishe."

The position of the average grey-iron foundry to-day is far from being satisfactory. In almost every trade journal of note one finds propaganda pushing the claims of steel, concrete, etc., *e.g.*, "Build with steel," "Use reinforced concrete for ——." And where is there a space devoted to the merits and advantages of cast iron? It is not to be seen! One doubts if there is another trade of such dimensions as the foundry trade without some sort of national advertising committee. The true value of national advertising schemes is best illustrated by the rapid strides made in all branches of the electrical industry. The steam engine as a power motive has almost completely given way to electrical power. Cast iron *must* push itself forward if it is to regain much of the ground already lost. We all know that it cannot be completely "ousted," but that is not the true point. The true point lies here—"are we getting our fair share of the trade at our disposal?" The answer is an emphatic "No."

Below is briefly outlined a table showing the physical competition now met with in various sections of the foundry trade. This table will be of greater interest to jobbing foundries, as several of the sections included are within their scope.

Ref.	Section.	Physical rivals.	Demand.	Remarks.
A	Columns	Steel and concrete	Big	Cast iron now little used.
B	Roof gutters	Almost nil	Big	Little competition.
C	Storage tanks	Steel and concrete	Fair	Competition keen.
D	Power plant	Electricity	Big	—
E	Power transmission	Steel	Big	—
F	Lintels, plates, etc.	Steel and concrete	Fair	Much rivalry.
G	Pipes	Steel and concrete	Big	Much rivalry.
H	Railings, gateposts, etc.	Wrought iron and concrete	Fair	Cast iron gaining ground.
K	General castings	Steel, cast steel, wrought iron, compositions, gum products	Fair	—

It will be seen from the above table that concrete and steel in their various forms are the chief rivals to cast iron. Other physical competition could be mentioned, but seeing that such would only represent a comparatively small percentage of the trade, it is hardly worth while considering in this article.

Now, consider in brief each of the sections given in the preceding table, discussing each without favour or prejudice—or as near to it as an ally of cast iron can hope to do.

Section A—Columns.

Although cast-iron columns are still used, steel stanchions are rapidly taking their place. The latter are strong, comparatively cheap and easy to erect, but one must not forget, however, the compression qualities of cast iron. Also its resistance to rust as compared with steel. In workshops where the atmosphere is continually moist or damp cast-iron columns should hold sway. Shafting and gearing are supported more easily from columns than stanchions, for it is a simple matter to cast preparations on the former to receive gearing brackets, etc. Cast iron can surely claim an advantage in this respect, and if space would permit other advantages could be readily defined. For large stores and similar types of buildings steel is undoubtedly in a very safe position, but in factories, such as those used for cotton spinning and weaving, bleaching and dyeing, etc., cast iron ought to be the choice every time.

Section B—Roof Gutters.

In this section of the trade there is not as yet any competition really worthy of note, although in the case of light gutters (plumber's gutters) many forms of composition are trying to gain a foothold. As regards heavy roof gutters (12 in. × 8 in., 12 × 7 in., etc., and similar sections) these are almost solely made of cast iron. In isolated cases, however, concrete and steel have been used. A watchful eye should be kept on such attempts to gain access to this section of the trade. So long as the "north-light" type of roof is held in favour by many manufacturers the demand for heavy cast-iron roof gutters must continue. It is therefore up to the trade to push this type of roof, for in doing so, not only are they advocating an admirable type of roof for many purposes, but at the same time are keeping the trade to a large extent in their own hands. In this type of roof all the roof standards (on the glazing side) are also of cast iron—not to mention the gutter hooks, etc. Perhaps the "north-light" roof is not very familiar to southern readers, but in the North and Midlands it is a common thing. In summing-up this particular section of the trade one is pleased to say that cast iron has held its own, and one can only hope that no effort will be spared to keep what is already attained.

Section C—Storage Tanks.

One need not look very far back to the time when storage tanks and similar cisterns were made universally of cast iron. To-day it can be pretty safely assumed that 50 per cent. of the trade is lost to pressed steel and reinforced concrete. The best kind of tank is undoubtedly one made of cast iron. Steel and concrete are cheaper—thus the chief reason of their success in ninety cases out of a hundred. And yet one sometimes wonders if the customer is fully acquainted with the basic facts, or is he somewhat blinded by the splendid advertising of steel and concrete tanks. Pressed steel can claim two advantages over cast iron in relation to tanks, namely (1) they are lighter in weight, and (2) much cheaper—especially in large-capacity tanks. Concrete can really only claim that it is cheaper and perhaps advantageous in uncommon shapes. Cast iron can claim three advantages over pressed steel, however:—(1) Stronger than the average pressed steel; (2) will stand up against variable weather much better, and does not need painting so often, and (3) will fetch a better scrap value.

As regards reinforced concrete, there is little doubt that cast iron is better in many respects apart from cost. Thus we see that with some really efficient advertising and cheaper production costs (*e.g.*, the standardisation of tank plates) the demand for cast-iron tanks would substantially increase. One cannot hope to regain all the lost tank trade—that is impossible—but even a 15 per cent. increase, say, would repay us for our efforts, and that small percentage is surely not too much to expect under the circumstances outlined.

Sections D and E—Power Plant and Transmission.

To discuss this section thoroughly would take too much space. As it is, we must admit that electricity is now the chief motive power of the country. The advent of such power, aided by electric motors, etc., has dealt a severe blow at power-transmission and gearing engineers. Shafting is not required to the same extent as prior to the war. Consequently pulleys, brackets, hangers, pedestals, couplings, etc., have all suffered a check—all cast-iron products! The steam engine seems on its last legs—a great pity considering that it is yet the most economical power generator in the country. Even in power-transmission appliances, cast iron has many rivals. Wrought-iron pulleys, cast-steel wheels, etc., seem to have gained ground—more especially the former. Pressed-steel pulleys are now invading the market, with price considerations as the main factor. Bring cast iron down to the price of wrought-iron pulleys and the customer will choose cast iron in the majority of cases. It seems a tragedy that he is not willing to pay a little more for an article that is unquestionably better. Maybe he needs a little more convincing—or perhaps the merits of cast iron ought to be continually brought home to him.

Section F—Lintels, Floor Plates, etc.

Here again one encounters concrete and pressed steel. One can hardly claim advantages for any in this section. Consequently it resolves itself into a war of keen competition.

Section G—Pipes.

For high pressures, such as boiler piping, superheated steam, etc., steel pipes are without doubt the best, and, in fact, in most cases cast iron would not stand up to the job. For low pressure and water mains, etc., cast iron (and cast iron concrete lined) ought to hold their own. Concrete pipes have no doubt captured much of the trade, especially in the big sizes, but with the spun pipe cast iron will score a big success. One feels pleased that in this section of the trade ironfounders display much enterprise.

Sections H and K—Railings, Gateposts, General Castings.

Cast iron is now being used for railings more than is generally supposed. Several important seaside resorts are adopting it, and very pleasing designs are being made. In fact, in appearance it surpasses wrought iron by incorporating modernistic features, and, moreover, it is cheaper. It will also stand up to the salt air, and that is something wrought iron will not do, unless painted and scaled very regularly. Concrete posts and railings are used fairly extensively, but after having been in use a year or so they can hardly claim to be a thing of beauty. Of course, concrete has a peculiar appeal to many people, but in smoky districts it is soon discoloured, thus losing its smart appearance. One feels that in this section cast iron could easily gain an almost new trade if it were properly nursed.

In the general castings section price is again the chief feature, and the same remarks as expressed in Section F are applicable.

Conclusion.

After carefully studying the above observations one must agree the early remarks of this article are only too true. At the same time one can see that there is still plenty of scope in the trade if times were anything like normal. In high-duty iron, however, we ought to have a great selling factor. Providing some standards could be determined or a committee appointed to deal with the matter efficiently, high-duty iron ought to be a boon to the foundry industry. If one of the national associations could be induced to deal with the publicity side of things it is certain that a great benefit would be ultimately derived.

[The author has omitted municipal castings. At the recent Shipping, Engineering and Machinery Exhibition a Black Country firm was showing pressed-steel manhole cover. The Gray Iron Institute in America has a department devoted to the issuing of propaganda for grey iron castings.—Editor.]

Unsoundness in Aluminium Sand Castings.

PART II.—THE EFFECTS OF USING METAL PREVIOUSLY SUBJECTED TO CORROSIVE CONDITIONS.*

By Prof. D. Hanson, D.Sc., and I. G. Slater, M.Sc.

Introduction.

It is a matter of frequent experience in the foundry that the incidence of pinholes in castings made from various batches of virgin aluminium ingot is very variable. Whilst such variables as melting and casting practice and the human element all contribute to these irregularities, the occasional marked differences observable, particularly when the source of supply is changed, seem to point definitely to some inherent quality in the virgin aluminium or stock alloy used.

Arising out of their previous work on the action of water vapour on aluminium,† and from a consideration of the chemical behaviour of the metal, the authors were led to consider if action between solid metal and moisture could produce the kind of deterioration frequently observed. The present Paper includes the results of their investigations in this direction.

Experimental Methods Employed.

Virgin aluminium ingot and aluminium alloys of specified composition were used for these tests in the form of the usual 3-lb. notched bar. The method of preparing these materials is explained later in the Paper. After various types of exposure or treatment of the notched-bar ingot, the latter was melted in an enclosed Leeds-Northrup wire-wound resistance furnace and cast as soon as the temperature had risen to 700 deg. C. About 3 lbs. of metal were used for each test, and the melt was poured into a taper block moulded in skin-dried green sand. Before exposure, the ingots were cleaned free from grease and any surface contamination by swabbing with acetone.

Preliminary Experiment.

A supply of virgin aluminium ingots (O.P.) having identical composition, gas content, and of known "age," was prepared by melting 60 lbs. of high-grade metal in a Salamander crucible in a coke-fired furnace. The melt was carefully controlled, and cast immediately after melting into standard 3-lb. notched-bar ingot moulds. Temper alloy (50/50 per cent. copper-aluminium) was similarly prepared from cathode copper and some of the virgin aluminium ingots.

The temper alloy was not exposed, but was stored in a dry place. After exposure, the virgin aluminium ingot was melted in the electric furnace with the requisite quantity of temper alloy to make up the "3L11" composition (6-8 per cent. of copper), exactly similar proportions being used in each instance to give an identical final composition.

The prepared ingots were exposed under the following conditions:—

(*a*) *Exposure Indoors.*—Ingots were stored on a concrete floor in the laboratory, where the atmosphere was moderately dry and the temperature fairly constant.

(*b*) *Exposure Outdoors.*—Ingots were suspended vertically on a wooden frame about 3 ft. from the grass in the University grounds, where they were subject to all-weather conditions, including rain, dew deposition, etc.

(*c*) *Immersion in Water.*—A large earthenware jar, filled with Birmingham tap water, was used for this purpose.

(*d*) *Exposure to a Water-saturated Atmosphere.*—The ingots were placed on a wooden platform just above the level of the tap water in the bottom of an earthenware jar having a narrow neck.

(*e*) *Chemical Pickling in Hydrochloric Acid.*—Ingots were immersed in a 10 per cent. aqueous solution of hydrochloric acid, and left for 24 hrs., by which time chemical action had ceased, leaving the ingots deeply etched and pitted.

(*f*) *Electrolytic Pickling.*—This was carried out in a 10 per cent. solution of hydrochloric acid using a current of 5 amps. Ingots of aluminium were used for both electrodes; no deposition takes place in this solution, hydrogen being liberated at the cathode, and oxygen at the anode.

Table I.—*Effect of Various Treatments on Virgin Aluminium.*

Ingot No.	Exposure.	Density.	Appearance.
120	None—remelted immediately	2.790	Practically sound.
122	" " "	2.788	" "
131	(*a*) Exposed indoors for 2 months	2.789	Very few pinholes.
129	(*b*) Exposed outdoors for 2 months	2.775	Moderate.
192	Exposed outdoors for 6 months	2.770	Moderately bad.
127	(*c*) Immersed in water for 2 months	2.753	Very bad.
130	" " "	2.760	"
199	Immersed in water for 6 months	2.743	"
128	(*d*) Exposed to water-saturated atmosphere for 2 months	—	Moderately bad.
124	(*e*) Chemically pickled in 10 per cent. HCl for 24 hrs.	2.783	Moderate.
155	Chemically pickled in 10 per cent. HCl for 48 hrs.	2.781	"
156	(*f*) Electrolytically pickled as cathode, 4 hrs. at 5 amp.	2.794*	Few.

* Rather higher copper content than others.

Results of these tests are given in Table I.

In every instance, after the exposure made, a deterioration occurred in the virgin aluminium ingot, as was evidenced by the presence of pinholes in varying quantities, and the decrease in density in the test-blocks cast from them. Excluding the pickling experiments, the maximum deterioration was found with the ingots which had been more severely corroded.

Two months indoors sufficed to tarnish slightly the initially bright surface of the virgin aluminium ingot. Exposure out of doors for two months resulted in more severe corrosion and the production of typical pits containing a whitish incrustation, this effect being still more marked after six months' exposure. Ingots immersed in water were more severely attacked, loose pockets of gelatinous hydroxide forming in quantity on the surface of the metal.

From these tests, the conclusion appears to be substantiated that the exposed virgin aluminium ingot absorbed gases which resulted in the increased number of pinholes apparent in the castings subsequently made. The only gas likely to be produced and absorbed by the metal under these conditions is hydrogen, which may be evolved in the nascent state either by direct reduction of aluminium by water or as a result of electrolytic corrosion. The evidence suggests that the latter was the major cause, since local corrosion, *i.e.*, electrolytic corrosion, was observable on all exposed specimens. It is well known that nascent hydrogen, under suitable conditions, readily penetrates other metals, and there is no reason to believe that similar penetration will not occur with aluminium. It is most probable that hydrogen is absorbed in quantity by the metal during the corrosion, and is retained even on melting, in sufficient amounts to be evolved as molecular hydrogen on solidification, causing unsoundness.

Additional evidence in support of this suggestion was found in the chemical and electrochemical pickling experiments. Nascent hydrogen and hydrogen ions respectively are liberated at the metallic surface, and castings made from virgin aluminium so treated contain pinholes. That the unsoundness in these ingots is less marked, although the amount of hydrogen liberated at the surface of the metal must be many times greater than in the other exposures, must be accounted for by the difference in conditions of corrosion, the surface of the metal, rate of attack, and a possible time/absorption factor.

Further Experiments.

It was decided to extend the exposure tests to certain of the aluminium alloys, and to repeat experiments with a fresh batch of virgin aluminium ingot. For this purpose, 100 lbs. each of the following alloys were prepared through the courtesy of William Mills, Limited, in their foundry: virgin aluminium (P.F.); "3L11" alloy (3L11.F.); "2L5" alloy (2L5.F.); "Y" alloy (Y.F.), and 12 per cent. silicon alloy (S.F.).

Each alloy was prepared separately in one melt and cast into 3-lb. notched-bar ingots. It was considered essential that the test-blocks obtained from the alloys immediately after production should be practically free from pinholes, and this was effected by the use of a fluxing treatment for the "3L11" and "2L5" alloys, and by the more drastic chlorine and nitrogen treatment for the "Y" and 12 per cent. silicon alloys. The two latter alloys were melted directly from readily-prepared metal and the others from best-quality virgin aluminium ingot and 50:50 per cent. copper-aluminium temper alloy with the addition of spelter for the "2L5" composition. A coke-fired tilting furnace was employed in order to minimise any gas absorption on melting.

As many as possible of the exposure tests were commenced immediately after the production of the ingots. Other ingots not required were "dry stored" in galvanised bins made airtight with a suitable rubber band, phosphorus pentoxide being used as a desiccating medium.

Exposure tests were made as follow:—

(*a*) *Dry Atmosphere.* In the sealed bins desiccated with phosphorus pentoxide.

(*b*) *Good Storage.* On a wood-block floor in the Dome Laboratory, where the temperature remained practically constant (65 ± 5 deg. C.) and rarely fell below dew point, the average humidity being 60 ± 5 deg. for the whole year, independent of season.

(*c*) *Ordinary Storage.* On a concrete floor at ground level in an annexe to a large building; approximating to ordinary factory or warehouse storage. The temperature occasionally fell overnight to below dew point, and the humidity varied from 60 to 100 deg., according to weather conditions.

(*d*) *Exposure Outdoors (Inland).* As in (*b*), Preliminary Experiments.

(*e*) *Exposure Outdoors (Marine Atmosphere).* On a wooden frame about 3 ft. from the grass on a site exposed to all-weather conditions, a few hundred yards from the sea on the Yorkshire coast.

* Abstract of a Paper read before the Zürich Meeting of the Institute of Metals. The work described forms part of a research on aluminium castings carried out on behalf of the British Non-Ferrous Metals Research Association.

† See "Unsoundness in Aluminium Sand Castings," Part I, FOUNDRY TRADE JOURNAL, September 24 and October 1.

(*f*) *Immersion in Water.* As in (*c*), Preliminary Experiments.

(*g*) *Chemical Pickling in Hydrochloric Acid.* As in (*e*), Preliminary Experiments.

(*h*) *Accelerated Salt Spray.* Specimens were suspended vertically under a temporary roof exposed on three sides and sprayed daily with a salt solution containing 10 per cent. sodium chloride and 2 per cent. magnesium chloride (hygrosoopic). The object of this test was to determine whether such exposure would prove a satisfactory alternative to the more prolonged atmospheric corrosion tests.

After suitable periods of exposure, specimens were removed and melted in the electric furnace to give standard test blocks for examination. The virgin aluminium (P.F.) was converted into a "3L11" alloy by the addition of the requisite quantity of dry-stored 50:50 per cent. copper-aluminium temper alloy, as previously described.

Results of tests made to date (April, 1931) on exposed specimens are given in Table II.

The deterioration on exposure of the original batch of aluminium ingot is confirmed by the tests on all the alloys. The extent of this deterioration appears to be dependent not only on the severity of the conditions of corrosion, but also on the composition of the alloy. Thus the "3L11" and "2L5" alloys suffered very much less deterioration relatively than the "Y" and 12 per cent. silicon alloys. Virgin aluminium "P.F." was the least affected, and, on the whole, appeared to be slightly less sensitive to exposure than the virgin aluminium "P.O." used in the preliminary experiments. It cannot, of course, be immediately assumed that the percentages of the major constituents present in the alloys control entirely the amount of deterioration likely to occur on exposure.

Dry storage (*a*) and good storage (*b*) resulted in practically no appreciable deterioration. With ordinary storage (*c*) "Y" and the 12 per cent. silicon alloys commenced to show unsoundness to a moderate extent even after only three months' exposure. Exposure outdoors (*d*) resulted in much more rapid deterioration with all alloys, so that after six months' exposure extensive pinholing was encountered in all specimens. Similar tests in a marine atmosphere (*e*) produced a slightly less serious effect for the same period of exposure. Acid pickle (*g*) and accelerated salt spray (*h*) showed some deterioration, but insufficient in some cases to make such tests of use as a satisfactory alternative to the more prolonged atmospheric corrosion.

Exposure of Temper Alloy.—A sample of 50:50 per cent. copper-aluminium temper alloy was exposed outdoors for six months and melted with dry-stored virgin aluminium ingot "P.F." to give a test-block of identical composition with the "3L11" alloy made up from the virgin aluminium ingot. The resulting test-block (No. 193) had a density of 2.803 and showed visually very few pinholes. It would appear that the temper alloy suffers little deterioration after such exposure.

Attempted Restoration of Exposed Ingots.—Virgin aluminium ingot "O.P.," which had been immersed in water for two months, was heated in an electric tube furnace for 4 hrs. at 500 deg. C. in a stream of dry nitrogen. The test-block cast from this material showed little improvement in soundness and had a density of only 2.763. Another sample of "O.P.," which had been pickled chemically in 10 per cent. hydrochloric acid for 24 hrs., was made anode in a similar solution carrying a current of 5 amps. for 4 hrs., oxygen being liberated freely at the surface of the metal. Again no very appreciable improvement was observable. The stability of the aluminium/hydrogen solid solution phase, if such is formed under suitable conditions of corrosion, appears, therefore, to be quite marked.

Tensile Tests on Unexposed and Exposed Specimens.—The following tests were made to determine whether changes occur in physical and mechanical properties of virgin aluminium and aluminium alloys on exposure and corrosion.

Test-bars 1 in. in dia. by 8 in. were cast from virgin aluminium "P.F." and the four alloys "3L11.F.," "2L5.F.," "Y.F." and "S.F." at the time of making the original notched-bar ingots. These were cast into the usual chill moulds (*c*-castings) and into dry-sand moulds (*s*-castings). The bars were machined to + 20 thousandths of an inch above the test diameter of 0.564 in. for the exposure, and then machined to size immediately before breaking. Duplicate tests were made so far as the number of specimens available would allow. One set was exposed outdoors for three months as in (*b*), Preliminary Experiments, and another set was pickled chemically in 10 per cent. hydrochloric-acid solution for 24 hrs. The 20 thousandths of an inch machining allowance sufficed adequately to clear up all the corroded area of specimens exposed outdoors, but the pickled specimens had in certain instances corroded locally more deeply, which would result in a deleterious effect on tensile properties additional to those produced separately by any absorbed gases. The results of these tests are given in Table III.

The yield point was determined by the dividers method, which is rather unsatisfactory and gives somewhat inconsistent results with cast aluminium alloys. The results as a whole, although not showing great consistency, nevertheless indicate that some deterioration occurred after exposure. Percentage elongation decreased quite appreciably in most instances, which phenomenon has been associated with the presence of absorbed and occluded gases in other metals—for example, with steel which has been pickled. These tests are not yet sufficiently conclusive to enable any final conclusion to be reached; it is possible that inter-granular pitting or corrosion might be responsible for the observed deterioration, although no sign of this was observed, either on the machined surfaces or the fractures.

Table II.—*Effect of Exposure on Light Alloys.*

Exposure.	Virgin aluminium P.F.			"3L11" alloy, 3L11.F.			"2L5" alloy, 2L5.F.			"Y" alloy, Y.F.			12 per cent. silicon alloy S.F.		
	Ingot.	S.G.	Appearance.	Ingot.	S.G.	Appearance.	Ingot.	S.G.	Appearance.	Ingot.	S.G.	Appearance.	Ingot.	S.G.	Appearance.
None	143	2.807	Practically sound	139	2.827	Practically sound	140	2.969	Practically sound	148	2.746	Practically sound	146	2.656	Practically sound.
(*a*) Dry atmosphere: 6 months	238	2.807	„ „	233	2.825	„ „	234	2.972	„ „	235	2.745	„ „	236	2.655	„ „
(*b*) Good storage: 3 months	191	2.805	Practically sound	187	2.828	Practically sound	188	2.972	Practically sound	189	2.737	Practically sound	190	2.651	Very few.
6 months	237	2.811	„ „	224	2.827	„ „	225	2.976	„ „	226	2.729	Few ..	227	2.644	Few.
(*c*) Ordinary storage: 3 months	185	2.807	Very few ..	181	2.827	Practically sound	182	2.961	Few ..	183	2.727	Moderately few	184	2.640	Moderately few.
6 months	239	2.800	Few ..	220	2.823	Very few ..	221	2.960	„ ..	222	2.727	„ „	223	2.644	„ „
(*d*) Outdoors inland: 3 months	180	2.794	Moderately few	176	2.813	Few ..	177	2.939	Moderate ..	178	2.666	Bad ..	179	2.623	Moderately bad.
6 months	240	2.786	Moderate ..	228	2.806	Bad ..	229	2.934	Bad ..	230	2.651	„ ..	231	2.629	„ „
(*e*) Outdoors marine: 3 months	205	2.802	Moderate ..	242	2.822	Few ..	243	2.952	Moderately few	244	2.714	Moderately bad	245	2.608	Bad.
(*f*) Immersion in water: 1 month	158	2.797	Moderately few	159	2.825	Few ..	160	2.959	Few ..	167	2.727	Few ..	166	2.626	Bad.
3 months	194	2.790	Moderate ..	195	2.802	Moderately bad	196	2.962	Moderately few	197	2.728	Moderate ..	198	2.609	„
(*g*) Pickled in 10 per cent. HCl: 24 hrs.	150	2.795	Moderate ..	144	2.834	Practically sound	145	2.974	Very few ..	152	2.734	Very few ..	151	2.601	Moderate.
(*h*) Accelerated salt spray: 1 month	241	2.810	Very few ..	206	2.834	Few ..	207	2.969	Very few ..	208	2.747	Few ..	209	2.646	Few.

Conclusions.

(1) Both samples of virgin aluminium ingot and all the alloys, when exposed to suitable corrosive conditions and subsequently sand-cast, are found to be unsound and to contain pinholes.

(2) The extent and amount of unsoundness found depend on the type and time of exposure, and also on the particular alloy examined.

(3) "Y" alloy and the 12 per cent. silicon-aluminium alloy appear to be more sensitive to these conditions than "2L5" and "3L11" alloys.

(4) Exposure for six months indoors under good conditions of storage produces practically no deterioration, whilst samples exposed for six months outdoors and cast are found to be very unsound and to contain large numbers of pinholes. Intermediate results are obtained with correspondingly less severe atmospheric corrosive conditions.

(5) Chemical and electrochemical pickling in 10 per cent. hydrochloric acid solution can produce a similar deterioration.

(6) Two attempts have been made to restore exposed and deteriorated metal, one by heating

at 500 deg. C. in a stream of nitrogen, and the other by electrochemical pickling as anode. Both methods were unsuccessful.

(7) Tensile tests on exposed samples show that a deterioration of the tensile properties of sand- and chill-cast bars is probable, particularly with regard to the elongation.

(8) The suggestion is made that the deterioration is the result of electrolytic action on corrosion involving the liberation of hydrogen in the nascent state which is absorbed by the metal. On remelting and casting, the hydrogen is evolved in the molecular condition, and produces the pinholes.

General Comments.

It is quite clear from the foregoing experiments that both aluminium and its principal alloys can deteriorate very seriously under suitable conditions of exposure to moisture. Whilst the evidence does not perhaps amount to proof, it seems almost certain that the deterioration is due to the decomposition of water and the passage of some of the hydrogen into the metal, where it is held in some form of "solution." On remelting, some or all of the hydrogen is retained in the molten metal, but is evolved during solidification, and gives rise to unsoundness. This theory calls for some amplification, for it may well be asked why, if the hydrogen is rejected when the metal solidifies, it should be possible for it to dissolve in such substantial quantities in the solid metal. Some explanation also is required to account for the negligible deterioration under conditions of normal exposure indoors, since there is always a very substantial concentration of water vapour in the air of an ordinary room. It is suggested that hydrogen passes into the metal in the nascent state; the occlusion of large amounts of hydrogen by other metals such as copper, iron, zinc and nickel under conditions of electrolytic action is well known, and the amount of hydrogen which can be absorbed in this way is very much greater than can be dissolved in the metal by exposing it to molecular hydrogen. In the nascent state, hydrogen consists of a single proton, and it is to be supposed that such an exceptionally minute particle can pass into the metallic crystal far more readily than any other particle of matter. Under the conditions of the authors' experiments, deterioration occurred only in those cases in which there was also evidence of electrolytic action as shown by the existence of local corrosion and the accumulation of hydrated corrosion products. Under some conditions of indoor exposure this did not occur, and it is well known that aluminium can be maintained indoors in a warm room or laboratory for many years without any sign of local corrosion. If, however, the material is stored under conditions which permit contact with liquid water, as, for example, by the deposition of dew, contact with rain, etc., conditions become favourable for electrolytic action, and it is supposed that the hydrogen which is generated under such conditions at the cathodic areas passes, in part at least, into the solid metal. The amount of hydrogen necessary to produce the degree of unsoundness which the authors have found is quite small, and could certainly be accounted for by the amount of corrosion which has been observed.

The rate of deterioration varies rather widely with different materials, and the time factor is probably important. The authors' attempts to hasten the process by various forms of accelerated action have been only partly successful.

All materials now reported on are liable to this deterioration in a greater or less degree, but although some—for example, the silicon alloy and "Y" alloy—were very definitely more affected than the others, the authors are not yet prepared to say that this is due to the major constituents of those alloys, for the aluminium itself differed in these two instances from that used for the copper and L5 alloys. They have, moreover, observed that different batches of virgin aluminium vary in their susceptibility to deterioration on exposure, and in one instance a very pure sample of aluminium was found to be much more slowly affected than the other samples examined. If the theory outlined above be correct, these observations are only to be expected, since it would be anticipated that anything tending to promote electrolytic corrosion would favour deterioration; it will doubtless be found that certain constituents, both impurity and alloying, definitely accentuate the actions, but it is also possible that under severe conditions of exposure any sample of aluminium will be affected in the course of time. It is proposed to study further the influence of composition.

Certain practical considerations at once arise from this research. It is clearly necessary that ingots of aluminium and its alloys must be stored under better conditions than those commonly found in many foundries, particularly when stocks are held for long periods. There is no doubt that much of the gas in commercial aluminium alloys is introduced by exposure of the solid metal to moisture between the time when it leaves the producer's furnace and the time when it is finally melted in the foundry, *i.e.*, during transport and in store. Gas so introduced may remain in the molten metal in sufficient quantities to give defective castings, even under the best melting conditions—as, for example, in electric furnaces.

It is not, of course, suggested that good metal cannot be damaged by bad melting practice; care is required in the foundry, whatever the condition of the ingots, and it is difficult to prevent some deterioration, especially in furnaces using coal, gas or oil as fuel, owing to the high content of water vapour in the atmosphere. Coke-fired furnaces are definitely less likely to damage good metal, whilst electric melting is still better, and, with proper care, sound sand castings can be obtained from either type of furnace, provided that the metal is initially good.

The use of scrap metal requires careful consideration in the light of the authors' results. Scrap arising in any foundry can be controlled and stored in a suitable manner in that foundry, but many works are obliged to use miscellaneous scrap from outside sources, much of which has been either in service or exposed under injurious conditions; usually it is corroded to a greater or less degree. Such scrap is likely to contain a high gas content, and should be treated accordingly, either by being subjected to a degassing process or by being reserved for work in which trouble from this cause is not likely to be experienced, such as chill castings or very thin sections.

The authors have worked principally with sand castings of large section, and the degree of unsoundness which they have observed is related to this large section. This fact does not in any way affect their conclusions regarding the amount or character of the gas absorption of the metal as a result of exposure to moisture, but the degree to which this absorption is serious in the foundry will naturally depend on the nature of the castings to be made.

Table III.—*Strength of Light Alloys after Exposure.*

Alloy.		As received.			Exposed outdoors—3 months.			Pickled in 10 per cent. HCl for 24 hrs.		
		Yield. Tons per sq. in.	Break. Tons per sq. in.	Elongation. Per cent. on 2 in.	Yield. Tons per sq. in.	Break. Tons per sq. in.	Elongation. Per cent. on 2 in.	Yield. Tons per sq. in.	Break. Tons per sq. in.	Elongation. Per cent. on 2 in.
P.F.	S	2.44	4.76	26	2.0	6.0	25	2.6	5.2	37
	S	2.0	4.9	29	2.2	4.72	26	2.6	5.52	50
	C	3.0	4.4*	15	2.4	5.54	43	2.2	4.48	13
	C	2.84	5.56	38	—	—	—	—	—	—
3L11.F.	S	6.88	7.72	4½	6.0	6.88	1½	3.6	5.88	1
	S	5.12	7.2	3	5.4	6.48	2	4.52	5.85	2
	C	4.48	11.36	6	7.0	9.2	3	4.6	9.4	4
	C	7.8	11.6	7	6.4	11.52	5	5.0	8.12	3
2L5.F.	S	7.0	11.28	7	5.6	10.0	5	5.2	8.56	3
	S	5.2	10.8	7	—	—	—	5.6	8.16	3
	C	5.68	15.48	9	7.12	13.44	6	6.0	15.12	9
	C	7.2	14.88	11	6.4	12.96	5	4.8	13.76	9
Y.F.	S	—	10.8	2	8.4	10.0	3	—	—	—
	S	8.8	10.84	3	—	—	—	—	—	—
	C	8.8	12.92	3	9.2	14.8	2	7.6	14.4	2
	C	9.6	14.8	3	—	—	—	8.4	14.0	2
S.F.	S	5.2	8.0	4	3.4	6.0*	—	4.4	6.16	1½
	S	4.32	8.08	—	—	—	—	—	—	—
	C	6.0	11.7	7	6.8	12.0	5	6.0	10.56	4
	C	4.8	12.2	6½	—	—	—	6.0	11.6	5

* Unsound.

Company Meeting.

Palmers Shipbuilding & Iron Company, Limited.—The annual meeting of Messrs. Palmers Shipbuilding & Iron Company, Limited, took place at Newcastle-upon-Tyne on September 30. Mr. C. F. Spencer (chairman of the company), who presided, said the depressed condition of the industry during 1930 did not warrant the resumption of operations at the rolling mills. The plant, however, had continued to receive such attention as was necessary to minimise deterioration. Business in the heavy industries in this country was very difficult, and the export trade had been declining month by month. In 1913 the average monthly exports of iron and steel were over 400,000 tons, whereas in 1930 they reached slightly over 260,000 tons monthly. This year he was afraid that the average monthly exports would be little more than 150,000 tons. On the other hand, the average monthly imports of iron and steel in 1913 were little more than 180,000 tons, whereas last year they were over 240,000 tons. The accentuated depression caused them to refrain from resuming the manufacture of pig-iron, for which the demand had been considerably curtailed. Their stocks of iron were being disposed of as opportunity offered. In their shipyards during 1930 they launched ten vessels having a total gross tonnage of 65,896, which included 39,028 tons launched from the Hebburn yard. For shipbuilding, as for other industries, the year was one of extreme anxiety and disappointment. Last year was conspicuous for the absence of inquiries and orders placed for all classes of vessels.

Messrs. Clarke, Chapman & Company, Limited, Gateshead-on-Tyne, announce that they have received another order for the powdered-fuel equipment for a Japanese steamship. This is the second order they have booked in Japan during the last few weeks, and will bring the list of vessels fired by the "Resolutor" pulveriser up to nine.

Staveley Sand-Spun Pipe Works.

OFFICIAL OPENING.

The new sand-spun pipe works of the Staveley Coal & Iron Company, Limited, were officially opened last month, when a large number of engineers and founders were invited to inspect the plant.

Sir William B. M. Bird (chairman of the Staveley Company), in welcoming the visitors, said that there appeared to be an impression that one of the chief causes of the slump in the heavy industries was that methods of production in this country were old-fashioned and out-of-date, and it was with the object of dispelling that fallacy, and of showing what the Staveley Company had done, and was doing, to keep abreast with the times, that they had invited the guests there that day. The Staveley Coal & Iron Company, Limited, was one of the oldest in the kingdom; their archives went back to the year 1702, and iron pipes had been manufactured at Staveley for certainly the last 100 years. Referring to the sand-spun pipe plant, which had been in course of erection during the past 18 months, and which is now in operation, the speaker said that before embarking upon that venture their technical experts visited the various pipe plants of their competitors on the Continent and in the United States of America, and it was in the latter country that they found what in their opinion was the best and most economical method of production. They had been able to make some material improvement even upon their methods which experience showed to be useful, and they now believed they had the most up-to-date and economical plant in existence.

Referring to the advantages of the sand-spun pipe, Sir William Bird pointed out that as the pipe was homogeneous, without dirt or blowholes, and was of increased tensile strength, due to the increased density of the metal, it was possible to reduce the thickness, and, therefore, the weight of a centrifugally-cast pipe, as compared with the pit-cast variety, without sacrificing any of the safety factors. It was for that reason that the 16-ft. Staveley sand-spun pipe was approximately the same weight as the B.S.S. 12-ft. pipe. Again, as the thickness was reduced, and the outside diameter was the same in order to make it mesh with the B.S.S. pipe, it followed that the bore of the sand-spun pipe was greater than the B.S.S., with correspondingly increased carrying capacity.

Whilst the Staveley method allowed for pipes being made of almost any thickness, it was thought that the standard thicknesses in the specification should be sufficient for all ordinary purposes. For instance, whilst the test pressure specified for 6-in. Class B pipes was according to their specification, the equivalent of 400-ft. head of water, their pipes were actually tested up to about three times that head.

That the pipes would give satisfaction there was no doubt, and it was interesting to note (concluded Sir William) that although the plant was not operated until early in June, they had already sold fifty miles of pipes.

Bailie John Henderson, of Glasgow, replying for the guests, referred to the fact that the Staveley Coal & Iron Company was the second company in Great Britain to be formed under the Joint Stock Companies Acts, the date of its incorporation being 1863. The Barrow family had a long and honourable association with the firm, and a member of that family was still on the board. In the early days the employees were probably numbered by hundreds. To-day there were 12,000 employees at the company's collieries, ironworks, chemical works, and ironstone mines. Some idea of the magnitude of their operations could be got from the fact that they had 3,500 cottages for the housing of their people, and owned over 7,000 railway wagons. The company's guiding policy had always been progress in industrial methods, coupled with conservatism in finance. The conception of the Devonshire Works, commenced in 1907, was due entirely to the vision and foresight of the late chairman, Mr. Charles Markham, a veritable captain of industry. The works area embraced four blast furnaces, and their appurtenances, the largest range of coke ovens in the Midlands, and all the innumerable chemical and by-product plants resulting therefrom. The firm distilled their own tar, as well as that of several other important undertakings, and extracted therefrom a wider range of products than any other tar distiller. They were large makers of sulphate of ammonia, for which purpose they constructed their own sulphuric-acid plants, capable of an output of 600 tons a week.

Further, the Staveley works turned out about 100,000 galls. of motor spirit per month, and, again, they worked up this benzol by treatment with their own sulphuric acid and nitric acid into aniline oil for the aniline-dye industry.

Care for the welfare of the workers exercised a great deal of thought and provision on the company's part, as witness the two pensions schemes, one for the staff and one for weekly workers; an efficient ambulance brigade numbering many hundreds; well-maintained houses let at low rentals and fitted with an ever-available supply of hot water; and pithead baths for colliery workers, as well as clubs for staff use.

World's Output of Pig-Iron and Steel in First Half of 1931.

Herr Adolf von Bülow (of Berlin) published in a recent issue of "Stahl und Eisen" some tables showing the average monthly output by the leading countries of the world of pig-iron (including ferro-alloys) and steel ingots and castings. The subjoined table has been compiled from his tables and shows in thousands of tons the average monthly output in the first six months of 1931 and in the 12 months of 1930. Fig. 1 shows the graphs (as in the original) for five countries and the world's totals.

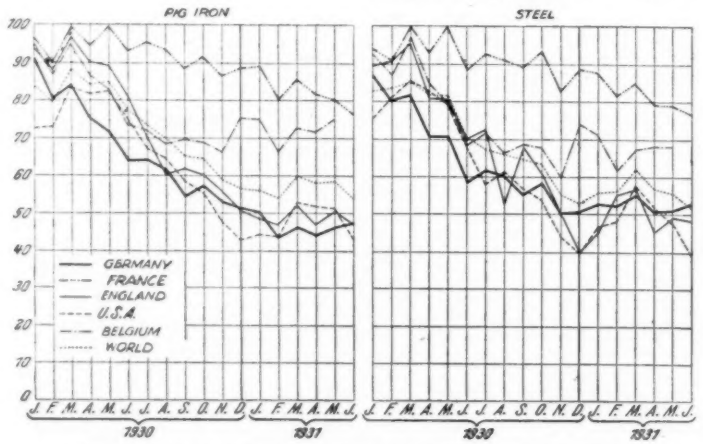


Fig. 1.—International Production of Pig-iron and Steel.

Table I.—*Average Monthly Output of Pig-Iron (inc. Ferro-Alloys) and Steel (1 = 1,000 tons).*

	Pig-iron.		Steel.	
	1930.	1931. Jan.-June.	1930.	1931. Jan.-June.
Germany ..	808	559	961	769
Saar district ..	159	136	161	142
France	842	743	783	693
Great Britain ..	525	340	641	473
Belgium ..	283	262	282	248†
Luxemburg ..	206	174	189	169
Czecho-Slovakia	119	101	153	133†
Poland	40	34	103	97†
Russia	418	427	474	445†
Italy	48	42	148	125
Sweden	38*	36*	57	44
Austria	24	11†	39	27†
Spain	56		73	
Hungary ..	21		31	
Holland ..	18	88‡	—	103‡
Other European countries ..	10		28	
United States ..	2,667	1,881	3,512	2,597
Canada	69	54†	86	61†
Japan	138	87†	188	138†
British India ..	84		29‡	
Australia ..	21	105‡	22‡	50‡
Other countries outside Europe	22		12‡	
World's total	6,616	5,078†	7,972†	6,328†

* Without ferro-alloys. † Partly estimated. ‡ Estimated.

Catalogues Received.

Power Transmission.—The Coventry Chain Company, Limited, and Hans Renold, Limited, of Manchester, have sent us their price list for 1931. Attention is called to the fact that the Brampton mark transmission chains have been withdrawn from the market, but that alternatives are available under either the Renold or Coventry mark. On page 97 we noted with interest the Renold cutting chain for mortising wood and many other materials of similar hardness. It seems that it is fully described in Leaflet No. 230/07. We think this would interest some of our pattern-shop readers.

Steel Castings.—The receipt from Head, Wrightson & Company, Limited, Thornaby-on-Tees, of a 20-page brochure, served to remind us that it must be about 12 or 13 years ago since we made the first cast of liquid steel for this foundry. Now we find that the plant has been materially extended and constitutes an important factor in the British steel-foundry industry. The brochure largely centres around a series of photo-micrographs of the different steels manufactured, and we suggest that these might, with advantage, have been made about 2½ in. wide, because one is so used to examining structures under these conditions that probably a better conception is given. Generally speaking, facing each micrograph is a picture of either a casting or a group made from the particular grade illustrated. The firm has followed the excellent precept of trade-marking all their castings Hed-Writ, and, undoubtedly, where possible each pattern should bear this indication, though we notice that some are marked simply H.W. We are not specialists at monograms, but our art department assures us that H.W. lends itself excellently to adaptation for this purpose. Another criticism we have to make is the labelling of the grades alphabetically, because the *flâneur* may imagine that B quality is inferior to A, and so on. We are pleased to find that unlike some foreign sellers of castings, no graph has been produced showing the British Standard specifications, which represent *minimum* requirements, and superimposing above them the average or even best tests to be obtained from the firm's manufactures. This is bordering on sharp practice, and, so far as we know, no British firm has yet stooped to this practice. The booklet, which is available to our readers on request, is well illustrated, and should be preserved by buyers, as an unvarnished and truthful story of the potentialities of the issuing firm to fulfil steel-castings requirements.

Steel after pickling is liable to be brittle. The addition of a small amount of pyridine or quinoline to the pickling bath will reduce this.

Twenty Years' Advance in Electric Arc-Furnaces for the Production of Iron and Steel.

By W. E. Moore.

(*Concluded from page 204.*)

The Girod Furnace.

The Girod electric furnace was introduced in the United States in 1908. This furnace was equipped with a plurality of electrodes, generally three, hanging vertically and adjustable by automatic means. The furnace was built with cylindrical shells having live bottoms, consisting of a plurality of steel studs connected through the flat furnace bottom and refractories. While the electrode system was arranged to be operated as three single-phase electrodes, with the current flowing from each electrode through the slag, through the metal, and down through the studs of the bottom, they were in practice, it is believed, usually operated with three electrodes connected in tri-phase formation. These furnaces were not designed for rapid operation, and while capable of doing good basic work, were slow and wasteful of power, electrodes and refractories, so that that type of furnace has now gone almost entirely out of use in the United States.

The Stassano Furnace.

The Stassano furnace had three downwardly-inclined electrodes entering from the sides of the cylindrical shell and made a so-called "free-burning" or blowing-arc, intended to blow down by reason of the magnetic reactions on to the bath and hearth. However, the radiation in an upward direction was so intense from these inclined electrodes that it was practically impossible to keep refractories in the roof or upper parts of the furnace shell unless the furnace was operated at an extremely slow rate. These furnaces likewise have gone out of operation in the United States.

The Rennerfelt Furnace.

During the war the Rennerfelt polyphase electric furnace was introduced into America. This furnace, unlike the Stassano furnace, which had a cylindrical shell, was fitted with a box-like shell, rectangular, of horizontal section and with three electrodes on the "free-burning" arc system, the larger one extending in through the top and the two smaller electrodes horizontally in through the sides of the furnace. The electrodes were connected to a two-phase—three-phase Scott system transformer with the common return or larger electrode on top. This furnace was also hard on refractories and is now no longer used in the United States.

The Greaves-Etchells Furnace.

During the war the Greaves-Etchells furnace, built with a rectangular rocking shell, was introduced. This furnace was fitted with one or more unbalanced three-phase circuits consisting of two upright vertically-adjusted electrodes and a bottom contact extending from the shell into the bath. The voltage on the bottom electrode was of a lower order so as to balance the current between the bottom and the two top carbon electrodes. This system of electrodes was multiplied on the larger furnaces, consisting of two, four, or six top electrodes, each with a corresponding bottom contact, each set of electrodes having its own transformer group so that on the larger furnaces, the unbalance which was unfavourable in the small furnaces could be more or less compensated.

These furnaces were invariably built in rectangular shells, and their roofs were made of standard shape refractory rectangular blocks so that very heavy construction was essential to minimise warping and expansion. They were comparatively slow in operation, high in power and electrode consumption, unbalanced in load and were never used in large numbers, and are not now being made in America.

The Gronwall-Dixon Polyphase Furnace.

This furnace was introduced into the American market during the war. It was constructed with a cylindrical flat bottom shell of the Heroult type, mounted on rockers, but fitted with four vertically-adjustable electrodes entering through the roof, which operated on a four-phase star electric system having the neutral grounded in the furnace bottom. The transformer system was connected on the Scott two-phase—three-phase formation. These furnaces were never manufactured in quantity, are now practically out of use and no longer manufactured in the United States.

The Brooke or Swindell Furnace.

This furnace was promoted as a multiple-shell or turntable furnace, there being two shells mounted on a circular turntable set in the floor with one set of electrode masts stationary with relation to the turntable, and arranged with three electrodes in triangular formation for three-phase power, quite like the Heroult. The claims made for this furnace were that one furnace shell might be under the electrodes and charged and the process of melting in progress, while the other furnace shell was being tapped-off and later charged, ready for melting.

These furnaces were also arranged with pre-heaters in the shape of gas torches to heat the scrap after it had been charged into the idle shell; whereas, in the Snyder pre-heating system the charge of scrap was heated in a separate drop-bottom bucket by means of gas or oil burners and then charged hot into the shell. It was claimed that the double shell economised in time of charging and power consumption. However, it was quite evident that with one set of electrodes and two shells the radiation and heat convective losses were necessarily effective on two shells instead of on one, thus lowering correspondingly the furnace efficiency. The rotation of turntable to bring each of the respective furnace shells under the stationary electrode system also required hoisting the electrodes clear above the shell, which meant that they were exposed at an intense white heat to rapid oxidation and radiation, making it uncomfortable from the operator's standpoint and extravagant in electrode consumption. No turntables have been built for four or five years, and the reversion has been towards construction of the furnace with the tilting shell embodying the more expensive attached tilting-mast type of electrode structure.

The Greene Furnace.

On the Pacific Coast the Greene electric furnace has been in use at several points. This furnace was built on a simple elementary plan with a steel shell made up like a rolling barrel and generally fitted with three electrodes in line arranged for hand control. The furnace shell was lined with standard-shaped bricks and the three electrodes arranged in a row depending vertically along the furnace axis, the furnace door or doors being in the ends of the rolling barrel or shell.

The Ludlum Furnace.

This furnace was introduced during the world war. Its shell was of an elongated cylinder type with conical ends for the spout and charge door respectively, with a segmental cylindrical roof having three electrodes in line arranged along the axis of the cylinder. This furnace is no longer in commercial production and is now but little known in ingot shops or foundries.

The 'Lectromelt Furnace.

The 'Lectromelt furnace was commercially developed in 1916. It was at the outstart constructed as a three-phase, high-powered, rapid-type furnace, interchangeably arranged for either basic or acid operation, having three vertically adjustable electrodes arranged in triangular formation and entering vertically through the spheroidal roof. The electrodes were carried upon universally adjustable roller bearings, mounted on tubular columns tilting with the furnace shell.

This furnace shell was designed to tilt in two directions, backward, that is towards the charging door for slagging, and forward with the tapping spout for discharging; both tilting motions being through a wide angle, which greatly facilitated drainage and quick repairs of the bottom. The furnace was designed with counterbalanced duplicate doors located opposite each other on the shell and placed in the tilting plane of the furnace shell. The furnace was arranged to tilt on rockers attached to the sides of the furnace shell, so that there were no parts of the furnace mechanism under the shell, and so designed as to cause the spout stream when tapping to move in a substantially vertical direction, avoiding the necessity for racking the crane to keep the ladle under the stream.

The furnace shell was of cylindrical form with a spheroidal bottom. This bottom permitted inverted arching of the bottom brick which tended to make them secure against upward flotation and minimised the radiating and convective cooling surfaces of the furnace. These furnaces were equipped with adjustable reactors and adjustable transformer voltage taps, generally being provided for tapping six voltages. They were so designed as to permit of high-power input for the most economical rapid operation, making as many as 20 heats per 24-hr. day.

The spheroidal form of the furnace shell, together with its rapid operating features, greatly economised the per-ton-melted power consumption so that the furnaces were at once able to compete, where suitable scrap and power supplies were available, with open-hearth furnaces, not only for tool and alloy steels, but for ingots, forging steels and commercial bar steels as well. The 'Lectromelt furnace thus set an entirely new mark for rapidity and economy, which has since caused the trade generally to introduce radical changes into arc-furnace design.

The more recent developments of the arc furnace have been along lines for making chrome and nickel alloy steels, operating commercially, and producing carbon as low as 0.04 per cent. and even down to 0.004 per cent. carbon. This low-carbon furnace product had hitherto been considered practically impossible of production with the arc-type furnace and was thought to have been restricted entirely to induction furnace melting.

The 'Lectromelt furnace is provided with a sub-station located at one side or at right angles to the tilting plane of the furnace, whereas the Heroult and older furnaces had the sub-station located back of the furnace with the furnace tilting away from the sub-station, so that quite long cables with a large amount of slack were required to permit the forward tilting of the furnace, thus undesirably increasing the losses in the secondary cables.

Electric-Furnace Products.

The electric arc furnace has been developed commercially for grey-iron, chilled-iron and malleable-iron production, and is now in efficient commercial operation in a number of plants producing iron castings of superior quality, and keeping a ready continuous supply of metal on hand that permits mechanisation of foundry work by means of moulding and shake-out con-

veyors in a very efficient manner, so that savings up to £2 per ton of product are made available. The electric furnace has also permitted the manufacture of soft, machinable castings from all-iron scrap, without the necessity of purchasing the more expensive pig charge, the economy in charge alone often being sufficient to defray the conversion costs.

In many localities cheap scrap, such as cast-iron borings or steel turnings, is available at a cost far below the average cost of the usual 50 per cent. pig-iron charge required for cupola melting. The electric iron is always superior in strength, generally running 40 per cent. to 90 per cent. stronger than cupola iron, being more dense and closer grained and of a more uniform texture, and is readily liquefied when containing any desirable percentage of steel scrap.

Automobile piston rings of a high grade and of the thinnest sections are being made in the electric furnace without hard spots. Such automotive castings as carburettors as well as cylinder blocks are also especially adapted to and are being made of electric-furnace iron. The electric furnace will undoubtedly continue to make rapid progress in the iron foundry, whether for chilled iron, grey iron or malleable iron, wherever suitable supplies of scrap and power are available.

The 'Lectromelt furnace has been adapted to malleable iron production, both the duplexing and cold-melting processes being used. The electric furnace keeps a steady supply of superheated metal of accurately adjusted analysis available for mechanical moulding and pouring equipment, and materially reduces the cost of foundry operation, to say nothing of the superior quality of the product.

Size of Furnace.

In the largest sizes of furnaces, the time required for charging the furnace through a side door has become a matter of serious moment, even where the open-hearth type of charging machine and charging box is used. Those difficulties are especially apparent where bulky scrap must be used, often requiring charging of the furnace two or more times, with intervening melting periods to permit a sufficient weight of bulky charge metal to be put into the furnace crucible. This made it desirable to introduce the swing-roof type of top-charge furnace, in which the roof is hydraulically lifted and then swung to one side, out of the way, so that the furnace may be quickly and easily charged at one time full to the top of the crucible, by means of a large drop-bottom bucket handled by the overhead crane.

By this method of charging it is entirely feasible, even with light scrap, to charge the full rated capacity of the furnace at one time, and this within a period, from "tap" to "power-on," of about four minutes.

With the 'Lectromelt lift-swing-roof method of charging the furnace, neither the electrodes nor the roof blocks are tilted out of their normal position, so that no extra strains are introduced which would tend to loosen or break the electrode joints and crack and spall refractories. This method involves no increased maintenance whatever. The furnace cycle is materially shortened, and the average power load factor of the furnace is considerably improved by the rapid top-charging method, which is showing remarkable economies on the larger size furnaces in the plants where high production is in vogue.

The modern electric furnaces are now standardised in holding capacities ranging from 50 lbs. to 75 tons per heat. The very rapid operation of the electric furnace, as compared to the open-hearth furnace, permits a furnace of much smaller holding capacity to produce the same daily tonnage. Large open-hearth furnaces usually make only about two heats per 24 hrs. The electric furnace in the same period of time will make three to six times, or more, that number of heats; thus, the capacity of the melting-shop building, the craneway, the crane, the ladle and mould-set-up may be correspondingly reduced, making a marked reduction in the investment cost of the plant.

Operating Costs.

The electric-furnace investment cost, too, is much lower than the open-hearth investment cost of equivalent daily tonnage output capacity. The analysis of the product from the electric furnace is under closer control, usually permitting tolerances of about half those practicable on open-hearth product, and the melting losses are also less. It is confidently predicted that the rapid-type electric furnace will gradually displace a large percentage of open-hearth melting capacity for tonnage steel. At present, the electric furnace is absolutely necessary for the modern type of stainless steels, non-corrosive and heat-resisting alloys, which are coming so rapidly into vogue that they are already high tonnage products.

During this period of development the electrodes which have always been made of carbon or graphite have been markedly improved. They are now more uniform in diameter and straightness, more scientifically made, and have more accurately threaded screw joints, are made of less porous texture, are of materially higher electrical conductivity, so that now the carbon electrode cost, while higher per pound than in pre-war days, is lower per ton of metal produced. Electrode consumption formerly ran from 30 to 40 lbs. carbon per ton, whereas the present-day electrode consumption, under favourable conditions, with the rapid-acid-type electric furnace, usually ranges from somewhat below 8 to 12 or 15 lbs. of carbon per ton, and the graphite electrode consumption, on the same basis, ranges from 4 to 9 lbs. per ton.

The silica refractories for electric furnaces have been improved both as to design for better fitting, cheaper, quickly-placed blocks, having greater regularity of shape and uniformity of grain and with more attention paid to proper burning, resulting in refractory costs which are now materially lower than they were 20 years ago.

On large acid furnaces of the rapid type, the present-day refractory cost is kept down to 10d. a ton or lower, when the plant is operated continuously under favourable conditions. The basic-lined furnaces are, however, more expensive, the refractories generally costing about twice as much per ton as acid refractories.

The electric furnace has now been so perfected that the maintenance cost on the furnace is comparatively low—lower than on any other form of melting equipment. The shapes and placing of the refractories for modern electric furnaces have been so perfected that the freedom for expansion is sufficient to prevent spalling or cracking of the refractories when the furnace is allowed to cool over week-ends or longer periods. This damage is most ruinous to the refractories of open-hearth furnaces when similarly closed down.

Electric furnaces of the rapid type, when in steady, continuous operation, under favourable conditions, on acid steel, have power records as low as 450 kw.-hr. per ton and even as low as 400 kw.-hr. per ton. However, for the intermittent or less continuous operation the power consumption is necessarily higher, frequently running 500 to 600 kw.-hr. per ton. The power factor of the modern electric furnace generally runs from 80 to 90 per cent., and, with the new high-speed automatic regulator, objectionable surges on the present-day power systems are habitually avoided. In fact, the electric furnace is now considered a welcome load by power companies.

Many power companies at the present time partly or entirely strike off that part of the power charge known as "demand charge," where the furnace is run "off-peak," and in a number of cases electric furnaces are given "dump-power" load rates, with the condition that the furnace load shall be dumped at any time the power company should experience a shortage of power by accident or otherwise.

The electric furnace is, of all power-using equipments, no doubt, the largest user of power per any given number of employees; in other words, the furnace load may be "dumped" more readily than any other type of load, without throwing a large number of employees out of work, and for that reason such loads are being looked upon favourably and promoted by modern power executives.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

2,120. International Nickel Company, Inc. Iron, chromium, and nickel alloys. 353,448.

2,339. Mills, Limited, Exors. of J., and Macbeth, A. Means for securing railway rails to metal sleepers. 353,478.

5,327. Simpson, K. M. Method of producing ferro chrome. 353,406.

9,131. Montelius, C. O. J. Method of manufacturing screws. 353,449.

12,327. Hailwood, E. A. Metal castings. 353,497.

13,555. Baillot, A. Foundry moulding machine. 353,545.

26,045. Smith, Major, & Stevens, Limited, and Major, P. C. Apparatus for testing steel-wire ropes. 353,743.

27,393. Weiss, E. Rotary furnaces. 353,754.

30,319. British Thomson-Houston Company, Limited. Apparatus for sorting rods, tubes, or the like. 353,785.

32,113. Stewarts & Lloyds, Limited, and Dawson, H. Pipe joints. 353,798.

34,973. Bolt, W. H. Boxes for packing tinplates. 353,807.

37,833. I. G. Farbenindustrie Akt.-Ges. Production of metallic tungsten. 353,815.

38,743. Pressed Steel Company of Great Britain, Limited, and Buckle, H. L. T. Production of metal stampings. 353,820.

4,157. Mannesmannrohren-Werke. Method and apparatus for machining rolls for rolling-mills and the like. 353,829.

4,196. Demag Akt.-Ges. Tube draw benches. 353,830.

18,404. Cold Metal Process Company. Rolling metal. 353,525.

3,094. Junghans, S. Process for manufacturing aluminium alloys. 353,891.

Messrs. Davey, Paxman & Company, Limited, of Colchester, have recently received several orders for Diesel engines. The Bank of England have ordered through their contractors, Messrs. Drake & Gorham, Limited, London, four Paxman totally-enclosed heavy-duty oil engines; the Tenby Gas Consumers Company have ordered a six-cylinder Paxman heavy-duty engine; the Enniskillen Electric Light & Power Company, Limited, have ordered a three-cylinder heavy-duty engine; a six-cylinder heavy-duty engine has recently been ordered for locomotive use; the Great Western Railway Company have ordered two 45-kw. Paxman marine auxiliary sets, with generators, through the Sunderland Forge & Engineering Company, Limited; the Eagle Oil & Shipping Company, Limited, have ordered two Paxman propulsion engines, with Paxman reverse gears; and the company has also recently supplied a number of direct-propulsion sets to the Egyptian Government.

This Week's News in Brief.

Trade Talk.

The Fewdwyllt Tinplate Works, Port Talbot, which closed in February, were restarted recently.

Mr. Frank Shaw, Ghyllroyd Foundry, Guiseley, is paying a first and final dividend of 4s. 5d. in the £.

The Stanton Ironworks Company, Limited, near Nottingham, announce that Stanton spun-iron pipes are now available in lengths of 6 yds., 5 yds., 4 yds. and 3 yds.

Commander C. W. Craven, managing director of Messrs. Vickers-Armstrongs, Limited, stated at Newcastle recently that the firm had booked £200,000 worth of work in one week.

Messrs. William Gray & Company, Limited, of West Hartlepool, have booked an order for two steamers each of 8,500 tons deadweight for the West Hartlepool Steam Navigation Company, Limited.

The destroyers "Cygnet" and "Crescent," under construction at the Naval Construction Works of Messrs. Vickers-Armstrongs, Limited, at Barrow-in-Furness, have been successfully launched.

The L.N.E.R. have placed a contract with the British Power Railway Signal Company, Limited, for the resignalling of 30 miles of their main East Coast route tracks between York and Northallerton.

Operations have been resumed at the works of the Barrow Hematite Steel Company, Limited, which have been idle for some months. Two blast furnaces have been brought into operation, and this week the steel department, which had also been idle for some time, was restarted.

Agricultural & General Engineers, Limited, continuing their policy of co-ordinating the activities of their subsidiary companies, announce that, as from January 1 next, the manufacture of the products of their subsidiary company, Barford & Perkins, Limited, Peterborough, will be conducted at Rochester in conjunction with those of Aveling & Porter, Limited.

Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne, have launched another oil tanker, christened the "Gardium," of 11,500 gross tons, for the Anglo-Saxon Petroleum Company, Limited. The company has also completed an additional section for a floating dock erected at Wallsend two years ago and stationed at Port Stanley, in the Falkland Islands. The new dock section has a lifting capacity of 760 tons.

Messrs. Davy Bros., Limited, Park Ironworks, Sheffield, have just concluded some important contracts with Arcos, Limited, the representatives in this country of the Russian Government. In addition to the order for the reconstruction of a 6,000-ton forging press, they are at present building six forging manipulators to the Alliance Machine Company's designs, machines for which they are sole licensees for this country and abroad with the exception of the United States, Canada and Mexico. The manipulators under construction, which comprise one 10-ton, three 5-ton and two 3-ton sizes, are intended for the new plants now being erected in Russia. Further orders for the same destination include a number of "Davy" patent turning gears, for rotating forgings whilst they are being forged under presses, and a 5-ton charging machine of the "Alliance" type.

New Companies.

Improved Lagging & Engineering Company, Limited.—Capital £600. Directors: H. W. Franklin and E. Krews, 4, Hathaway Road, Grays, Essex.

Hartley Mettam & Company, Limited, Palm Tree Works, Attercliffe, Sheffield.—Capital £1,500. Steel merchants, etc. Directors: A. E. Hartley and F. Mettam.

Cronite Foundry Company, Limited, 5, Victoria Street, London, S.W.—Capital £36,000. Directors: F. J. Commin, A. Fergusson, K. A. MacAndrew and E. Pam.

Amalgamated Patents, Limited.—Capital £100. Combustion engineers and specialists, etc. Directors: W. J. Diamond, R. B. Beauchamp, R. H. James, "Onway," Bishops Road, Whitchurch, Cardiff; G. W. B. Beauchamp and A. W. J. Owen.

Personal.

Mr. H. M. Ridge has been appointed managing director of the N. C. Metal Company, Limited.

Mr. G. R. La Page, general sales manager of the Yates-American Machine Company, Beloit, Wisconsin, wood-working machinery manufacturers, is now on a business visit to Europe.

Mr. Robert Dunlop, foreman of No. 3 melting shop in the Dalzell steelworks of Colvilles, Limited, has just retired, and has received presentations from the directors, the management and the melters of the company.

Mr. Donald McDonald, B.Sc., F.I.C., has been elected hon. secretary of the Chemical Engineering Group of the Society of Chemical Industry, in the place of Mr. W. F. Darke, who has resigned on taking up a new appointment.

Mr. Eden Walker, brass-foundry foreman at the L.N.E.R. Plant Works, Doncaster, retired last week at the age of 63. He has served with the company for 28 years, and received presentations from his fellow-workmen on his retirement.

Mr. George A. Phillipson, who has been technical representative for the Coppée Company (Great Britain), Limited, has joined the Steel Band Conveyor & Engineering Company, Limited, of Birmingham, to represent them in London and the South.

Obituary.

Mr. Thomas Lake Aveling, formerly a director of Aveling & Porter, Limited, Rochester, died suddenly at the age of 75 whilst speaking at a meeting on Monday night.

Mr. William Dunn, chief of the clerical staff at the Hallside works of the Steel Company of Scotland, Limited, died at the age of 74 years. He had served with the company for 54 years, and once had the honour of being presented to the King as the company's oldest servant.

British Ironfounders' Association.

NEGOTIATIONS WITH MERCHANTS CONTINUED.

A meeting between light-castings ironfounders and representatives of the Irish merchants' association was held in Liverpool on September 29. There was a full attendance on both sides. The meeting was entirely harmonious and was obviously inspired, as all the other meetings with the merchants have been, with a spirit of conciliation and reasonable compromise, in the mutual desire to arrive at an agreement that shall be satisfactory to all parties. The terms were discussed and approved, and are for the most part on the same lines as the draft agreements negotiated with the English merchants. They will, of course, have to be submitted to, and ratified in due course by, the various associations concerned.

A similar meeting with the Scottish merchants was held in Glasgow on October 1, when a similar agreement was provisionally arrived at. There are some slight variations, due to local conditions of trade, between the agreements applicable to England, Scotland and Ireland, but the basis of the arrangement is substantially the same.

The joint conference with the English merchants was resumed in London on October 6, when a report was received, not only from the British Ironfounders' Association but from the four merchants' associations concerned, that the draft agreement had been finally approved by members of each organisation in general meeting. Consequently, on paper the agreement may be said to be complete. There were a few minor alterations, but none of them of any great substance.

(*Concluded on page 232.*)

Students' Corner.

(*Concluded from page 218.*)

Q.—In what way would the process differ if the weld was vertically performed?

A.—If a similar welding operation is performed vertically, which is sometimes an advantage with such a casting as a flanged cylinder, the crack being through the flange and down part of the body:—(1) A continuous row of ¾-in. dia. holes are drilled in a line with the crack, through the flange and thickness of the body of the casting, to the extent of the crack, or rupture, making a clear passage; (2) the casting is then brought into the vertical position, the bottom end of the crack should be a little above the floor-level in order to facilitate the run-offs; (3) the dried loam cakes are now shaped and temporarily fitted to the casting, both internally and externally, covering with a good margin of loam cake on either side and below and above the extent of the ruptured part; (4) the position of the run-offs is now determined, the holes being bored through the loam cakes; these are about 1 in. dia., tapered larger outward to about 2 in. dia., and are spaced about 3 in. apart in the vertical position. The bottom run-off is situated on a level of the bottom of the fracture, the top run-off flows over the top at the close of the burn; (5) the loam cakes are now removed, dressed, black-washed and completely dried. Pre-heating is now commenced; (6) after pre-heating, the loam cakes are replaced in their proper position. The backing and supporting floor sand is rammed as far as is necessary inside and outside the casting, and (7) when these preliminaries are completed, the welding metal from the ladle is directed from the open top of the flange and impinges on the bottom end of the fracture near the lowest run-off. When the metal below is thoroughly liquefied, this run-off is closed. The liquid metal then escapes through the next run-off above, and in a short time this is botted up; the process is continued until the top flow-off is reached. The open area is now played upon with the molten metal until the whole is in a molten condition. Pouring now stops, and when the metal becomes solidified it is covered with fine dry sand, and then with hot scrap from the run-offs, and slowly cooled.

Q.—Are welding methods available other than those practised in the foundry?

A.—Amongst the better known welding processes are: Thermit, oxy-acetylene and electric. These are usually performed outside the foundry by experts, who have little in common with similar work carried out in the foundry.

All processes have their limitations, but some can perform welds that are not a practical proposition to the foundryman. On the other hand, the foundryman can burn-on new parts which would be quite impossible by other methods. All processes take risks, and have successes and failures.

Recent Wills.

Reid, J. A., retired brassfounder, of Ayr	£7,246
Emery, S. C., a director of Emery Bros., Limited, Aston, metal rollers ...	£70,924
Lloyd, D. C., chairman of F. H. Lloyd & Company, Limited, James Bridge Steel Works, Wednesbury, steel founders	£72,101

Raw Material Markets.

Heavier purchases of pig-iron have been made during the past week, although there has been no material improvement in the position of the foundries. The chief reason for the sharp increase in the demand is that consumers are desirous of acquiring stocks against the possibility of an increase in prices, a development which is by no means unlikely. It is reported that there have been further heavy imports of Indian iron during the week. Steelmakers are receiving more inquiries, and several important contracts have been secured.

Pig-Iron.

MIDDLESBROUGH.—The position in the Cleveland iron market is greatly improved. The beneficial influence of the depreciation of the pound sterling upon the general industrial situation is now more fully understood, and consumers are not hesitating to acquire material for some months ahead. Foreign producers are transacting hardly any business, as they are, in most cases, quoting at the old rates of exchange. Hence the imports of Continental pig-iron into Scotland during the last week were negligible, while there has been a corresponding increase in the demand for Middlesbrough iron. If the present buying movement is continued, there is a prospect of more blast furnaces being put into operation. The producers have not made any alteration in their prices, which remain at the minimum level. No. 1 Cleveland foundry iron is quoted at 61s. per ton, No. 3 Cleveland G.M.B. at 58s. 6d., No. 4 foundry at 57s. 6d., and No. 4 forge at 57s. per ton.

There has been a big increase in the demand for East Coast hematite, and last week's turnover is the largest witnessed during the current year. Consumers continue to deplete the makers' stocks, in spite of the rise in prices. In the export section, there have been heavy inquiries from France, Germany, Italy and Scandinavia, and many purchases are being made. Prices are very uncertain, but 65s. per ton was paid in many cases last week for mixed numbers for prompt delivery. On the North-West Coast, the position is irregular. There has been a distinct increase in the demand, partly due to the restarting of the steelworks at Workington and Barrow, which are again producing railway material. On the other hand, the makers are still in possession of considerable stocks, while two more furnaces have been put into commission at Barrow. Prices fluctuate considerably, and are a matter for individual bargaining.

LANCASHIRE.—There is a distinctly better feeling in the Lancashire pig-iron market, although no great increase in consumption has taken place. Textile machinery makers report that there is no actual expansion in the demand as yet, but that future prospects are brighter, as more and more looms are now being put into operation. The light-castings industry has been making a much greater demand for pig-iron. Prices are unaltered. For delivery to users in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron remain at 67s. per ton, with Northamptonshire foundry iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at 86s. to 87s. and West Coast hematite iron at about 81s. per ton.

MIDLANDS.—There has been very heavy buying of pig-iron in the Midlands area during the last week or so. The sudden increase in the demand made by the foundries is due, not to any improvement in their actual consumption, but to a recognition that price levels may shortly have to be raised. There has been no change in controlled prices. For delivery to Birmingham and Black Country stations, the producers still name 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—There has been no noticeable change in the depressed condition of the consuming industries in Scotland, although future prospects are somewhat brighter. Only 620 tons of shipping were launched last month on the Clyde. However, owing to the absence of Continental supplies, and the possibility of future shortage, there have been slightly heavier purchases of pig-iron during the last few days, and the outlook, from the producers' point of view, is much improved. Scottish No. 3 foundry iron remains at 69s. 6d. per ton f.o.t. furnaces.

Coke.

It is difficult to gauge the strength of the coke market, as prices are so irregular. The Northumberland and Durham market is disturbed by the presence of several large stocks on offer, but the general tendency is much stronger, and the better blast-furnace qualities are quoted at 16s. and upwards delivered works. Foundry coke is also much firmer, and further increases in prices are not unlikely.

Steel.

The finished-steel market is a little stronger, although the position of the consuming trades has not materially improved. Plates and sections are suffering from lack of business, but, on the other hand, black sheets are in stronger demand. Continental quotations for bars have been withdrawn. Manufacturers of semi-finished material are receiving many more inquiries, as the result of the stoppage of Continental supplies, and prices have been increased. There is an improved demand for Welsh sheet and tinplate bars.

Scrap.

On the Cleveland market, the demand for scrap iron is not very brisk, but it is hoped that, with conditions improving in the foundry trades, there will shortly be an increase in consumption. Heavy cast iron continues to sell at 40s., and good machinery quality in handy sizes at 42s. per ton. The Midlands market is still weak, owing to the presence of large stocks, and the lack of any improvement in the demand. Good machinery quality cast-iron scrap is on offer at 45s. to 46s. per ton, and light cast-iron scrap at 37s. 6d. per ton, delivered. Business is very scarce in the South Wales market, and, in view of the poor prices offered by the consumers, holders are keeping off the market. On the Scottish market, consumers' needs are still very limited, and stocks are heavy. There is little demand for machinery cast-iron scrap at about 45s., and the latter level has been broken in some cases. Ordinary heavy cast-iron scrap is quoted at 38s. 6d. to 40s.

Metals.

Copper.—It is very difficult to determine the true position of this metal, as prices fluctuate so considerably, in sympathy with the sterling exchange rates. However, it is possible, by working out the figures at the old exchange rates, to see that the values of the non-ferrous metals have really increased very little, if at all. In view of the erratic exchange rates and the fact that the American producers are quoting in cents, consumers are not over-eager to buy. Hence there has been an increasing call for scrap metal. The American producers seem to have temporarily secured the New York market against the attacks of speculators, and it remains to see whether they can secure an effective control of output.

Closing quotations :—

Cash.—Thursday, £32 7s. 6d. to £32 8s. 9d.; Friday, £32 5s. to £32 7s. 6d.; Monday, £34 12s. 6d. to £34 15s.; Tuesday, £33 2s. 6d. to £33 5s.; Wednesday, £33 16s. 3d. to £33 17s. 6d.

Three Months.—Thursday, £33 5s. to £33 6s. 3d.; Friday, £33 5s. to £33 7s. 6d.; Monday, £35 12s. 6d. to £35 15s.; Tuesday, £34 2s. 6d. to £34 5s.; Wednesday, £34 16s. 3d. to £34 17s. 6d.

Tin.—The market is still very sensitive to the fluctuations in exchange rates, and the operations of speculators. Comment has been aroused by the fact that tin did not advance as much as it should have done upon the depreciation of sterling, but there is no ready explanation. There are hopes of an early improvement in the consuming industries in this country, whose purchases have already been the heaviest seen for a long time.

Official closing prices :—

Cash.—Thursday, £120 5s. to £120 10s.; Friday, £122 to £122 5s.; Monday, £125 15s. to £126; Tuesday, £124 10s. to £124 12s. 6d.; Wednesday, £124 2s. 6d. to £124 5s.

Three Months.—Thursday, £124 2s. 6d. to £124 5s.; Friday, £125 10s. to £125 15s.; Monday, £130 to £130 5s.; Tuesday, £128 12s. 6d. to £128 15s.; Wednesday, £128 5s. to £128 7s. 6d.

Spelter.—The position of this metal is not so favourable as it was. The demand made by the home galvanising industry, which had improved, has partially fallen off. Consumption in general is much lower than is normal for the time of year. The American spot price fell last Friday to 3.60 c. per pound—10 points lower than a week before, although it has since experienced a partial recovery.

Daily fluctuations :—

Ordinary.—Thursday, £12 6s. 3d.; Friday, £11 17s. 6d.; Monday, £12; Tuesday, £12; Wednesday, £12 3s. 9d.

Lead.—The demand for lead has fallen off somewhat, in spite of the increased call from abroad for finished lead products, by reason of the fact that most consumers covered themselves adequately during the temporary spurt of buying that occurred recently. Recent arrivals of lead have been on a more liberal scale, so that a further increase in value in the near future seems unlikely.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £13; Friday, £13; Monday, £13 5s.; Tuesday, £12 15s.; Wednesday, £12 15s.

British Ironfounders' Association.

(*Concluded from page* 231.)

It therefore now remains for a further approach to be made to the ironfounders at present outside the membership of the British Ironfounders' Association and also to certain prominent merchants, in order to try to secure their active co-operation. It is hoped that it may be possible in the near future to convene a meeting in London which will be fully attended by those concerned, and that the whole position may be discussed and the necessary additional strength obtained which will enable the agreement to be brought into operation.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone : 3852 (2 Lines). MIDDLESBROUGH. Telegrams : "Ritchie, Middlesbrough."

IMPORTANT NOTICE.

In January last we notified the British Foundry Trade through this Journal that a German Competitor, faced with a suit for infringement, had taken proceedings to have the principal Brackelsberg Patent annulled on the ground of prior knowledge, etc. After a lengthy hearing a decision was reached by the German Patent Office sustaining the Brackelsberg Patent in every particular, with the result that the application was rejected with costs.

An Appeal was entered against this decision, but this was withdrawn at the last moment, therefore the Brackelsberg Patent stands in its entirety and can now be considered stronger than ever.

Brackelsberg Furnaces are used for the melting of Iron and other metals in all the principal countries of the world, and are protected by a series of patents in Great Britain, Germany, the United States of America and other important countries.

BRACKELSBERG MELTING PROCESSES LIMITED,
Malaya House, 57, Charing Cross,
London, S.W.1.

Licensees for the manufacture and sale in Great Britain :—
Messrs. James Howden & Co., Ltd., Caxton House, Westminster, S.W.1.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	33	16	3
Three months	34	16	3
Electrolytic	41	0	0
Tough	35	15	0
Best selected	36	5	0
Sheets	75	0	0
India	47	10	0
Wire bars	41	0	0
Do., November	41	0	0
Do., December	41	0	0
Ingot bars	41	0	0
H.C. wire rods	45	0	0
Off. av. cash, Sept.	31	11	$1\frac{13}{16}$
Do., 3 mths., Sept.	32	9	$1\frac{1}{16}$
Do., Sttlmnt., Sept.	31	11	$1\frac{7}{16}$
Do., Electro, Sept.	36	12	$1\frac{10}{16}$
Do., B.S., Sept.	33	10	10
Do., wire bars, Sept.	37	1	$4\frac{1}{16}$
Solid drawn tubes			$10\frac{1}{2}$d.
Brazed tubes			$10\frac{1}{2}$d.
Wire			$7\frac{1}{2}$d.

BRASS.

Solid drawn tubes	$9\frac{1}{2}$d.
Brazed tubes	$11\frac{1}{2}$d.
Rods, drawn	$8\frac{1}{2}$d.
Rods, extd. or rlld.	$5\frac{1}{2}$d.
Sheets to 10 w.g.	$8\frac{1}{2}$d.
Wire	$8\frac{1}{2}$d.
Rolled metal	$7\frac{1}{2}$d.
Yellow metal rods	$5\frac{1}{2}$d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6d.

TIN.

	£	s.	d.
Standard cash	124	2	6
Three months	128	5	0
English	125	15	0
Bars	128	0	0
Straits	128	10	0
Australian	126	10	0
Eastern	133	17	6
Banca (nom.)	136	10	0
Off. av. cash, Sept.	117	17	$10\frac{1}{16}$
Do., 3 mths., Sept.	120	15	$8\frac{12}{16}$
Do., Sttlmt., Sept.	117	17	6

SPELTER.

	£	s.	d.
Ordinary	12	3	9
Remelted	12	0	0
Hard	9	5	0
Electro 99.9	14	10	0
English	12	15	0
India	11	10	0
Zinc dust	23	0	0
Zinc ashes	3	15	0
Off. aver., Sept.	11	16	$4\frac{1}{16}$
Aver. spot, Sept.	11	11	$5\frac{1}{16}$

LEAD.

	£	s.	d.
Soft foreign ppt.	12	15	0
English	14	5	0
Off. average, Sept.	11	19	$6\frac{3}{16}$
Average spot, Sept.	11	18	$7\frac{7}{16}$

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	22	0	0
Do., V.M. ex-whf.	24	10	0
Rods	30	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	25	0	0
Crude	19	0	0

QUICKSILVER.

Quicksilver (nom.) .. $80

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
25% .. 8 10 0 to 9 0 0
45/50% .. 10 0 0 to 12 0 0
75% .. 16 0 0 to 17 0 0

Ferro-vanadium—
35/50% .. 12/8 lb. Va.

Ferro-molybdenum—
70/75% c. free 4/2 lb. Mo. plus 20%

Ferro-titanium—
23/25% carbon-free $9\frac{1}{2}$d. to $10\frac{1}{2}$d. lb.

Ferro-phosphorus, 20/25% .. £16 0 0 to 17 0 0

Ferro-tungsten—
80/85% .. .. 1/8½ lb. plus 20%

Tungsten metal powder—
98/99% .. 1/11½ lb. plus 20%

Ferro-chrome—
2/4% car. (nom.) £33 0 0
4/6% car. (nom.) £25 0 0
6/8% car. (nom.) £24 0 0
8/10% car. (nom.) £22 10 0

Ferro-chrome—
Max. 2% car. (nom.) .. £34 10 0
Max. 1% car. (nom.) .. £39 0 0
Max. 0.70% car. (nom.) .. £40 10 0
70% carbon-free (nom.) .. 11d. lb.

Nickel—99% £215 0 0

Ferro-cobalt .. .. .. 8/6 lb.

Aluminium 98/99% £95 0 0

Metallic chromium—
96/98% .. .. .. 3/1 lb.

Ferro-manganese (net)—
76/80% loose £10 15 0 to £11 5 0
76/80% packed £11 15 0 to £12 5 0
76/80% export (nom.) £ 9 0 0

Metallic manganese—
94/96% carbon-free .. 1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over .. .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. .. 3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in. .. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. .. .. 3d. lb.
Do., under ¼ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. .. 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	..	..			2	2	6
Bundled steel and shrngs.	1	15	0	to	2	2	6
Mixed iron and steel	..	..	..		1	17	6
Heavy cast iron	2	0	0	to	2	5	0
Good machinery for foundries	..	..			2	7	6
Cleveland—							
Heavy steel	..	..			1	17	6
Steel turnings	..	..			1	5	0
Cast-iron borings	..	..			1	2	0
Heavy forge	..	..			2	7	6
W.I. piling scrap	..	..			2	0	0
Cast-iron scrap	2	0	0	to	2	2	0
Midlands—							
Light cast-iron scrap	..				1	17	6
Heavy wrought	..	..			2	1	6
Steel turnings, f.o.r.	..				0	14	6
Scotland—							
Heavy steel	..	..			1	15	0
Ordinary cast iron	..				1	18	6
Engineers' turnings	..				1	3	0
Cast-iron borings	..	..			1	10	0
Wrought-iron piling	..				2	2	6
Heavy machinery	..	..			2	5	0

London—Merchants' buying prices delivered yard.

Copper (clean)	..	28	0 0
Brass	..	20	0 0
Lead (less usual draft)	..	11	10 0
Tea lead	..	8	10 0
Zinc	..	6	10 0
New aluminium cuttings	..	56	0 0
Braziery copper	..	26	0 0
Gunmetal	..	23	10 0
Hollow pewter	..	78	0 0
Shaped black pewter	..	56	0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—
Foundry No. 1 .. .. 61/-
Foundry No. 3 .. .. 58/6
Foundry No. 4 .. .. 57/6
Forge No. 4 .. .. 57/-
Hematite No. 1 .. .. 65/6
Hematite M/Nos. 65/-

N.W. Coast—
Hem. M/Nos. d/d Glas. .. 74/6
„ d/d Birm. 85/6
Malleable iron d/d Birm. —

Midlands—
Staffs common* .. .. —
„ No. 4 forge* .. 61/-
„ No. 3 fdry.* .. 66/-
Shrops basic .. .. —
„ Cold blast, ord. .. —
„ „ roll iron .. —
Northants forge* 57/6
„ fdry. No. 3* .. 62/6
„ fdry. No. 1* .. 65/6
Derbyshire forge* 61/-
„ fdry. No. 3* .. 66/-
„ fdry. No. 1* .. 69/-
„ basic* .. .. —
*d/d Black Country dist.

Scotland—
Foundry No. 1 .. .. 72/-
„ No. 3 .. .. 69/6
Hem. M/Nos. d/d 68/6

Sheffield (d/d district)—
Derby forge 58/6
„ fdry. No. 3 .. .. 63/6
Lincs forge .. .. —
„ fdry. No. 3 .. .. 63/6
E.C. hematite 77/-
W.C. hematite 83/6

Lancashire (d/d eq. Man.)—
Derby forge 62/-
„ fdry. No. 3 .. 67/-
Staffs fdry. No. 3 .. .. 67/-
Northants fdry. No. 3 .. 65/6
Cleveland fdry. No. 3 .. 67/-
Dalzell, No. 3 (special) 102/6 to 105/-
Glengarnock, No. 3 86/- to 87/-
Clyde, No. 3 .. 86/- to 87/-
Monkland, No. 3 .. 86/- to 87/-
Summerlee, No. 3 .. 86/- to 87/-
Eglinton, No. 3 .. 86/- to 87/-
Gartsherrie, No. 3 .. 86/- to 87/-
Shotts, No. 3 .. 86/- to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	9	15	0	to	10	5	0
Nut and bolt iron	8	5	0	to	8	10	0
Hoops	..	..	..		—		
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	..	..	..		—		
Bolts and nuts, ¾ in. × 4 in.					—		
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	17	6	to	9	15	0
Chequer plts.	..	..			10	7	6
Angles	..	..			8	7	6
Tees	..	..			9	7	6
Joists	..	..	..		8	15	0
Rounds and squares, 3 in. to 5½ in.	..	..	..		9	7	6
Rounds under 3 in. to ¾ in. (Untested)	..	6	15	0	& up.		
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates	..	..	..		12	0	0
Hoops (Staffs)	..	..			—		
Black sheets, 24g.	8	5	0	to	9	0	0
Galv. cor. shts.	9	15	0	to	10	0	0
Galv. flat sheets	10	0	0	to	10	5	0
Galv. fencing wire, 8g. plain					—		
Billets, soft	5	5	0	to	5	12	6
Billets, hard	..	..			6	12	6
Sheet bars	5	0	0	to	5	5	0
Tin bars	..	..	..		5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	$11\frac{1}{4}$d.
Sheet to 10 w.g.	$12\frac{1}{4}$d.
Wire	$12\frac{3}{4}$d.
Rods	$12\frac{1}{4}$d.
Tubes	1/7d.
Castings	$12\frac{1}{4}$d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	16.26
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	12.00
Basic	17.26
Bessemer	18.76
Malleable	18.76
Grey forge	18.26
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 27/6
„ furnace	14/6 to 15/6
Durham and Northumberland—	
„ foundry	14/- to 15/-
„ furnace	13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		14/- to 14/6
„	28×20 „		—
„	20×10 „		—
„	18¾×14 „		—
C.W.	20×14 „		—
„	28×20 „		—
„	20×10 „		—
„	18¾×14 „		—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	0 0
Bars, hammered, basis	£16	10	0	to	£17	0 0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	5 0
Blooms	£10	0	0	to	£12	0 0
Keg steel	£32	0	0	to	£33	0 0
Faggot steel	£18	0	0	to	£23	0 0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Oct.	1 ..	32	7	6	dec.	20/-
,,	2 ..	32	5	0	,,	2/6
,,	5 ..	34	12	6	inc.	47/6
,,	6 ..	33	2	6	dec.	30/-
,,	7 ..	33	16	3	inc.	13/9

Electrolytic Copper.

		£	s.	d.		
Oct.	1 ..	40	0	0	dec.	10/-
,,	2 ..	39	10	0	,,	10/-
,,	5 ..	41	0	0	inc.	30/-
,,	6 ..	40	10	0	dec.	10/-
,,	7 ..	41	0	0	inc.	10/-

Standard Tin (cash).

		£	s.	d.		
Oct.	1 ..	120	5	0	dec.	52/6
,,	2 ..	122	0	0	inc.	35/-
,,	5 ..	125	15	0	,,	75/-
,,	6 ..	124	10	0	dec.	25/-
,,	7 ..	124	2	6	,,	7/6

Tin (English ingots).

		£	s.	d.		
Oct.	1 ..	121	15	0	dec.	55/-
,,	2 ..	123	10	0	inc.	35/-
,,	5 ..	127	10	0	,,	80/-
,,	6 ..	126	0	0	dec.	30/-
,,	7 ..	125	15	0	,,	5/-

Zinc Sheets (English).

		£	s.	d.		
Oct.	1 ..	22	10	0	dec.	10/-
,,	2 ..	22	0	0	,,	10/-
,,	5 ..	22	0	0	No change	
,,	6 ..	22	0	0	,,	,,
,,	7 ..	22	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Oct.	1 ..	12	6	3	dec.	11/3
,,	2 ..	11	17	6	,,	8/9
,,	5 ..	12	0	0	inc.	2/6
,,	6 ..	12	0	0	No change	
,,	7 ..	12	3	9	inc.	3/9

Lead (English).

		£	s.	d.		
Oct.	1 ..	14	10	0	dec.	20/-
,,	2 ..	14	10	0	No change	
,,	5 ..	14	15	0	inc.	5/
,,	6 ..	14	5	0	dec.	10/-
,,	7 ..	14	5	0	No change	

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	13 0 0	12 5 0	11 10 0	11 16 0	11 10 0	11 10 0	11 10 0	11 10 0	12 0 0	12 0 0	12 0 0	12 0 0	11 17 1
1902	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 14 2
1903	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 18 4
1911	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 19 7½
1912	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916	26 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 8
1918	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923	18 3 1½	19 1 11½	19 8 0	19 10 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2
1924	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 9 4½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	16 15 0	16 11 0½
1926	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	16 19 0	16 10 0½
1927	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928	13 0 0½	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929	13 11 0	13 13 1½	13 12 9½	13 10 11½	13 9 3	13 8 9	13 11 6	13 7 6	13 7 6	13 5 6	12 18 9	12 12 9½	13 7 5½
1930	12 5 0	11 15 0	11 19 6	11 18 7	11 18 0	11 17 6	11 17 6	11 17 6	11 16 3	11 12 6	11 8 9	11 5 0	11 15 11½
1931	11 4 0	11 0 0	11 0 0	11 0 0	10 13 9	9 18 9	9 13 0	9 5 3½	8 19 0½	—	–	—	—

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